POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
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Perils of Polar Flight

How Our Navy Experts Are Preparing for Conquest of Far North by Airship

By Lieut.-Comm. Fitzhugh Green, U.S.N.
Member of the special Naval Arctic Air Board appointed to supervise the "Shenandoah's" cruise over the Pole

For want of a nail the shoe was lost;
For want of a shoe the horse was lost;
For want of a horse the rider was lost—
All for the want of a horseshoe nail!

ARCTIC exploration is just like that. One tiny oversight, one nail or bolt or lacing missing at a critical moment, and the lives of daring men may be needlessly sacrificed.

No military campaign ever was planned with greater attention to detail than that of the Polar Air Expedition which the United States Navy announced for the dirigible *Shenandoah*.

Lessons of the Past

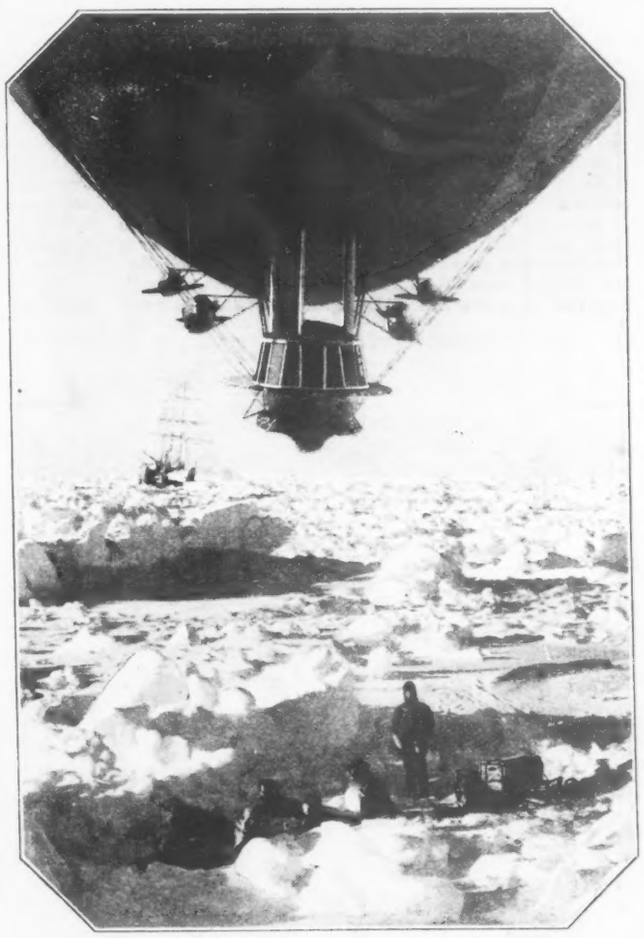
After more than a century of international effort, stippled with tragedy and crowned by Peary's superb achievement of the North Pole, we have come at last to know the incredible complexity as well as the unavoidable peril of polar work.

Consider the field of action. On the American side Nome is the most northern place available for a base. Point Barrow, Alaska, for instance, is not open until August. And ice conditions are so uncertain there that a ship could not stay long enough to be of real help to an air expedition. Somehow we think of Alaska as having the North Pole in her back yard, so to speak. Yet it is 1560 miles from Nome to the earth's apex!

Fierce Arctic Winds

Twice 1560 miles is more than 3000 miles. If an airship has a cruising radius of 4000 miles she theoretically can fly from Nome to the Pole and back with safety.

But a cruising radius is figured for still air. And Bering Strait is a veritable funnel. Cold northerly winds pour through it for weeks at a time. If the wind blows 40 miles an hour against an airship and the ship is making propeller revolutions for 60, her advance over the ground is only 20 miles an hour. With such a handicap the Nome-Pole flight would become proportionately 9000 miles! No airship ever designed could tackle such a journey.



In addition to all the icy terrors that in the past have confronted explorers in their daring and often disastrous attempts to reach the top of the world by ships and dog teams, the crew of an airship must be prepared and fully equipped to meet new and uncounted perils in an attempted polar flight. Buffeting air currents swirl about the Pole. Projecting nubbles of ice make the landing of an airplane hazardous, and the landing of a dirigible out of the question. The composite photograph above vividly illustrates these hazards

The point I wish to emphasize is that the Arctic is a vast place—something more than 3,000,000 square miles in the polar basin, one third of which is totally unknown! Enormous distances must be covered. No bases exist save those especially established. Wind conditions are little more than a guess. Hence, months of preparation in a myriad minute ways are essential for a final sally against the demon blizzards of the north.

The practical purpose of an air expedition northward is twofold: First, exploration of the unknown area of the Polar Sea north of Point Barrow. Second, establishment of the practicability of a transpolar route between Europe and Asia, with resulting trade advantages.

To Seek Unknown Land

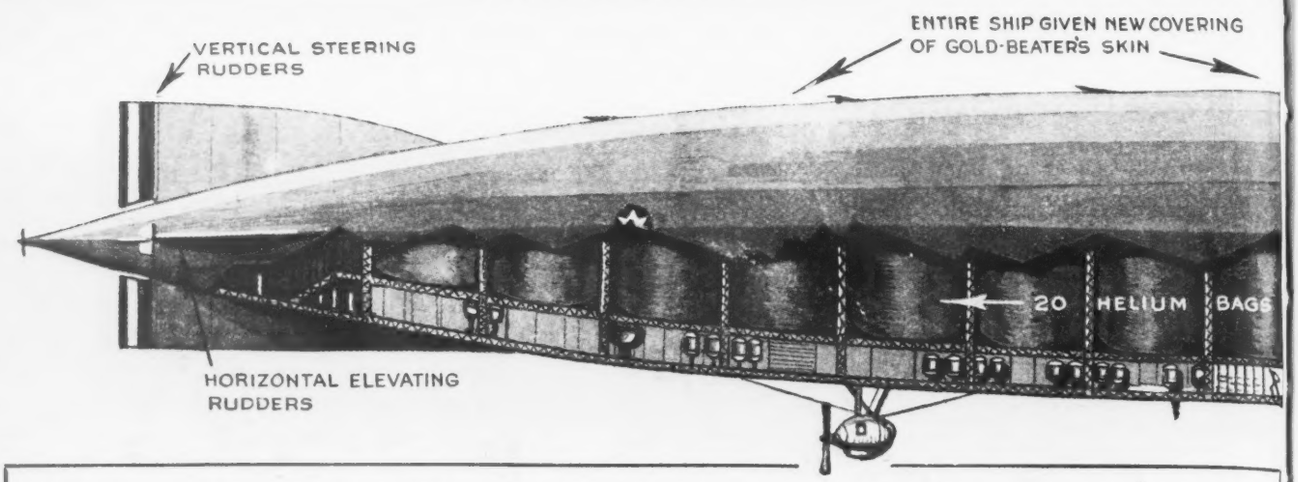
The first objective is the so-called "Pole of Inaccessibility." This is the center of the unknown area lying about 500 miles north of Point Barrow. Systematic flights over it either by plane or dirigible will determine whether or not land lies there.

The second objective is not only the accomplishment of a transpolar flight, but the collection of aerological data that will enable American commercial enterprise to enter this field with some idea of the feasibility of an arctic shortcut to Asia and Europe. Such accomplishment is in line with the peacetime uses of our naval forces. In like manner the Navy operates two ships engaged in scientific research for the Bureau of Fisheries.

Cold the Least Obstacle

Strange as it may seem, cold will be the least of all obstacles. Arctic temperatures are no more intense than those often experienced in our northern states. For five weeks in summer much of the Arctic receives more heat to the square mile than that received at the equator! Our Weather Bureau reports show that a temperature of 100° F. in the shade has been recorded in Alaska! Airplanes already have been flown in temperatures far lower than any that will be encountered on the coming expedition.

The thing about arctic cold is its *persistence*. A recording thermometer on the Polar Sea in any summer month will show about 30° F. day after day with but a


VERTICAL STEERING RUDDERS
ENTIRE SHIP GIVEN NEW COVERING OF GOLD-BEATER'S SKIN
20 HELIUM BAGS
HORIZONTAL ELEVATING RUDDERS

Science and Chance Play for High Stakes at the Top of the World

ONE important point to bear in mind in connection with the proposed polar exploration by dirigible is that in any case such an expedition can never be merely a spectacular feat of dashing adventure. It is essentially a useful undertaking of exploration, which, if successful, promises results of tremendous scientific and commercial importance.

In the accompanying article, Commander Green depicts vividly the almost unbelievable difficulties of arctic flying. He describes specific measures of the Navy to foresee these difficulties as far as possible before undertaking any flight as spectacular as has been proposed for the *Shenandoah*. Yet Uncle Sam's aviation experts know well that an infinite number of obstacles lie in wait for the forthcoming attempt to conquer the fierce air currents that swirl about the top of the world—obstacles that cannot be anticipated, nor guarded against by the most careful preparation. These unknown foes, as Commander Green points out, are reared by Chance, upon whose bounty those who dare the air in dirigibles are absolutely dependent for their success or failure. Witness the recent appalling disaster to the giant French dirigible *Dixmude*.

To be sure, the *Shenandoah* gave a splendid account of itself when it broke away recently from its mooring mast at Lakehurst, N. J. But such a ship cannot land as an airplane can. If its supply of fuel gives out, it is at the mercy of capricious air currents to a greater extent than even a balloon would be.

Maneuvering a dirigible near the ground is known to be virtually impossible. With helium gas supplying the lifting power, as in the case of the *Shenandoah*, great heights cannot be attained, because helium, expanding in rarefied atmosphere, would cause the bag to explode. That is why the Navy's plans for the trip have been shaped so that she must circle the United States on her way to Nome; she cannot ascend to heights sufficient to clear the mountains that lie in the path of a direct route. The theoretical cruising range of a dirigible, as Commander Green points out, is reduced appreciably in any but calm air. In other words, Chance plays a not unimportant part.

So the crew of the *Shenandoah*, if they start on their voyage over the frozen seas of the north are facing all the dangers that ever confronted a polar expedition, plus unknown and uncounted dangers. They will be adventuring quite as much as the pioneer polar explorers whose expeditions almost invariably resulted in disaster.

The whole world will wish them success, but the world must not be carried away by the glamour that surrounds their hazardous and daring adventure.

degree or two variation on either side.

"We never seemed to get thawed out!" exclaimed a friend of mine who has done some flying in Spitzbergen.

Coupled with unvarying low temperature is the uncomfortable dampness of the arctic summer air.

Both of these features have a bearing on the choice of equipment for the expedition. Lubricating oils must be light enough, yet able to stand exposure to severe cold in case any engine is forced to remain north through the winter. All metal parts and fittings must be surfaced to withstand the effect of the air's high moisture content.

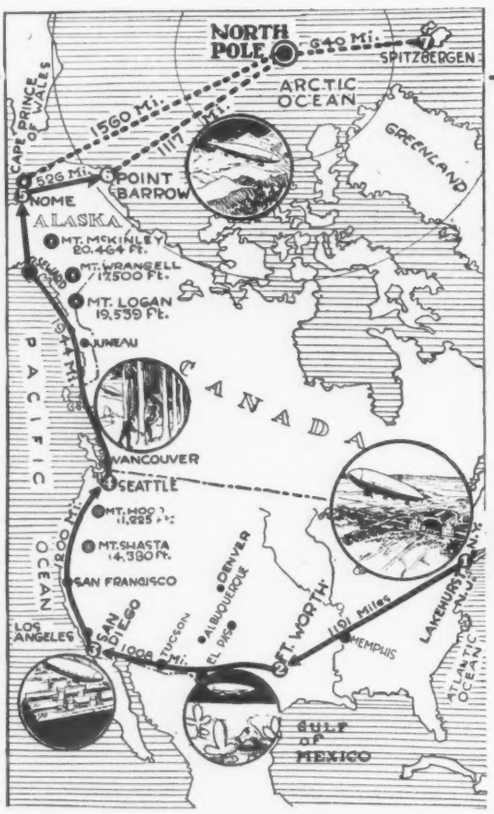
In allowing working time for such tasks as erection of mooring masts, hangars, and for repairs, a certain percentage always must be added for the numbing wind in which the men must labor. A freezing temperature is not severe. Often our carpenters work outdoors in colder weather than that. But in the north, where the sun's angle is low, where the cold wind's searching fingers never cease their prying, and where there is no such thing as noontime warmth, outdoor work becomes a serious problem indeed.

The aviator, confined to his narrow cockpit or control car, is supplied with special garments. Next to his skin he wears ordinary woolen underwear. Then comes an electrically heated suit of asbestos-like material. Outside he wears a closely woven windproof coat of burberry or skin.

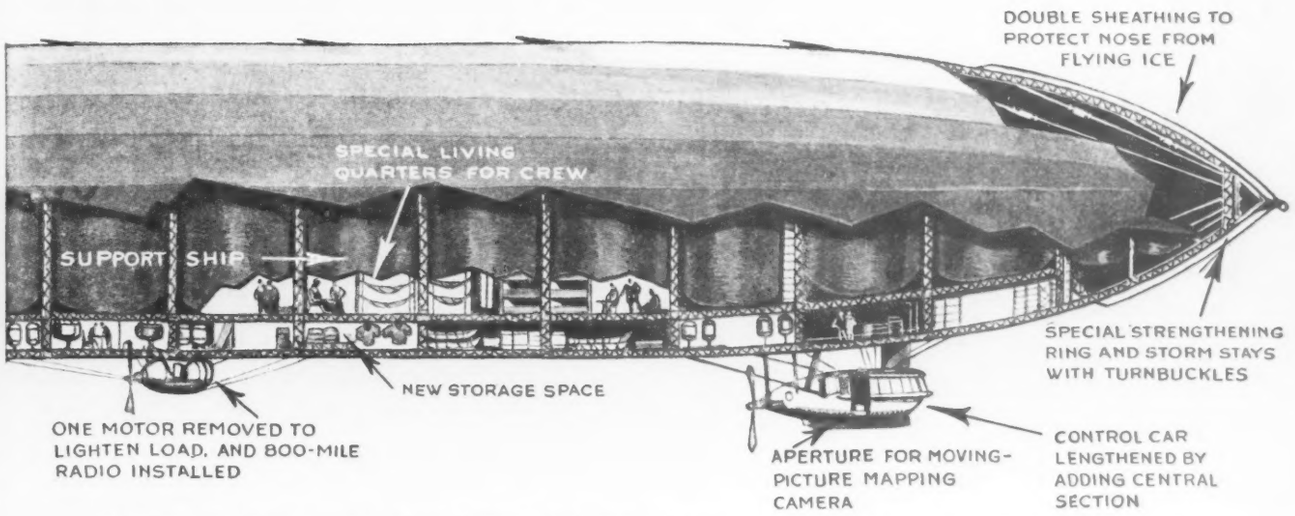
But cold can be anticipated. Wind cannot be. Winds are caused largely by heat. At the equator hot air rises and flows northward. Speaking broadly, in the arctic regions it cools and somewhere over the Polar Sea falls and pours south again. Theoretically it might thus be possible to fly high and have a fair wind to the Pole; then, by coming down near the earth's surface, to have the wind aft coming back.

The trouble is that we don't know just what to expect. The atmosphere at the poles is oblate or flattened, just as is the earth, only immensely more so. That is to say, while the atmosphere over the equator is thrown out by centrifugal force, near the Poles the reverse is true, and the depth of the atmosphere is tremendously decreased. Hence conditions of flying near the North Pole at an altitude of 5000 feet may differ greatly from those found over the United States at the same altitude.

Shortness of breath is a common result of rising high above the earth's surface. Most aviators breathe through their mouths at altitudes



The contemplated route of the *Shenandoah* from her hangar at Lakehurst, N. J., to the proposed Alaskan base at Nome, thence 1560 miles to the North Pole. The total distance from Lakehurst to the Pole over this circuitous course is 6903 miles


DOUBLE SHEATHING TO PROTECT NOSE FROM FLYING ICE
SPECIAL LIVING QUARTERS FOR CREW
SUPPORT SHIP
SPECIAL STRENGTHENING RING AND STORM STAYS WITH TURNBUCKLES
NEW STORAGE SPACE
ONE MOTOR REMOVED TO LIGHTEN LOAD, AND 800-MILE RADIO INSTALLED
APERTURE FOR MOVING-PICTURE MAPPING CAMERA
CONTROL CAR LENGTHENED BY ADDING CENTRAL SECTION

This diagrammatic cut-away view of the *Shenandoah* shows proposed alterations designed not only to protect and aid the great air cruiser in battling polar gales and ice storms, but to provide comfortable quarters and scientific equipment for the long cruise of exploration

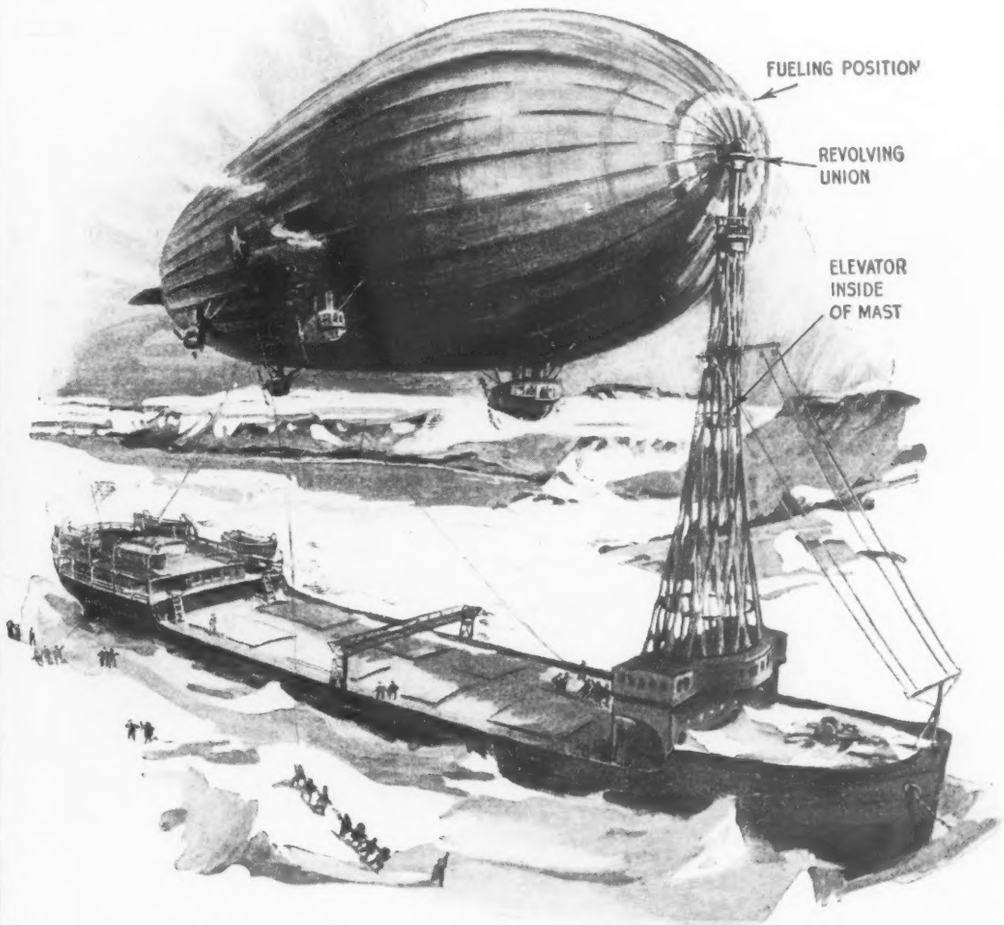
higher than 12,000 feet. At 15,000 feet the mere turning of the body to look around may aggravate breathlessness enormously. Since cold accentuates this respiratory weakness, it becomes one of the major problems of arctic flying.

One of the curious features of arctic navigation is the fact that the compass course toward the Pole from Point Barrow is a little *south of west!* The north magnetic pole lies in the North American archipelago above Canada. Toward it the compass needle points. Hence the paradoxical course that must be steered to reach the geographical pole.

There is a serious side to this matter. Static electricity is generally believed to be greater in polar regions than elsewhere on the globe. The aurora depicts upper air conditions in this respect. Moreover, the directive force of the magnetic pole on the needle is slight in high latitudes. Altogether the compass is a frail assistant.

There are variations of the compass over the Polar Sea that never have been investigated. If a dirigible's navigator at the Pole should wish to head for Spitzbergen, 630 miles due south, he would have something to worry about when he began to set his course. Frequent sun observations would be his best bet. That is, if there were no arctic fog on the job to prevent him.

The thrilling possibility of the expedition is that we may find land. We must be prepared to find it, at any rate, and this opens up a whole new list of troubles.



To provide dirigible anchorage in the Far North, the Navy is developing this type of mooring mast to be carried by supply ships. In its construction the lessons learned when the *Shenandoah* broke away from her mooring mast are being utilized. The mast will be built to withstand an end-on pull greater than that produced by the 70-mile gale at Lakehurst. It will be equipped with elevators for the crew, and pipe lines for water and gasoline. Motor winches will carry heavy loads up to the ship

Dangers of Landing

Take the airplane. To fly safely over the polar pack a plane must be equipped with pontoons for landing in the water that forms on the ice in summer, or in the open water between floes. On these pontoons must be runners for landing on ice or snow, if necessary.

So far so good. But every arctic traveler knows that visibility conditions on the ice pack in broad daylight often are so trying that even a man afoot constantly stumbles over projecting nubbles. Diffused rays of the sun and lack of shadows make the roughest ice-field look smooth as a table from an altitude of 500 feet. To land under such conditions would mean to wreck one's plane.

A dirigible is even more severely handicapped. At the present point of progress in this form of airship, a safe

(*Continued on page 150*)

"My Fellow Scientist—The Rat"

An Interview with Dr. E. V. McCollum, Famous Authority on Diet

By Norman C. McLoud

DR. ELMER V. McCOLLUM, professor of biochemistry at Johns Hopkins University, one of the world's leading authorities on food and diet, set out some time ago to find what foods were best for human beings. Man did not know, so Doctor McCollum asked the rat. How well the rat has answered is indicated by the fact that many scientists give Doctor McCollum credit for having done more than any other single investigator to determine the effects of food on the human body.

Advanced Food Science

But Doctor McCollum is not yet satisfied with the results of his work. He is still experimenting with rats, and with their aid expects to establish new principles of nutrition, which, it is safe to assume, will mean a longer, happier life for you and me. His laboratory-workshop at Johns Hopkins University in Baltimore is the seat of epoch-making revelations. In matters of food he is an investigating pioneer. To visit him is to have a glimpse of the show-window of advanced food science.

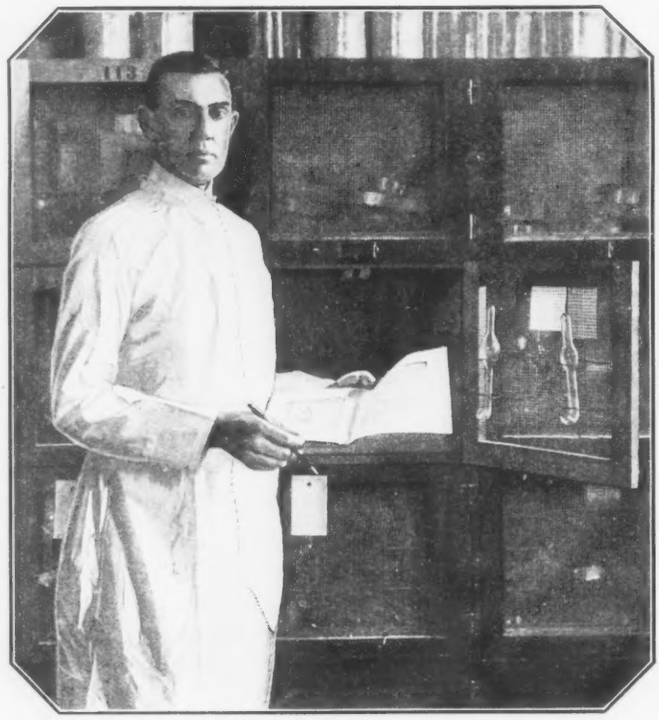
Rats play an important part in the story of the life and works of this scientist. They scamper through the tale as through a cheese shop. In the contest with mice for this distinction the rats triumphed because of their dignity. A mouse is frisky and uncompromising; a rat is gifted with poise and understanding. It is because of this superiority that McCollum has been able to make rats his fellow workers in scientific discoveries.

A Laboratory Full of Rats

In his laboratory are hundreds, sometimes thousands, of them. Cages in rows line the walls and the floor, each heavily screened. Here and there the quick flitting of a tail shows that a cage is occupied. He feeds his rats with this food and that, observes the effect on them, and then translates his conclusions into terms of food for human beings. By regulating the diet of his rat associates, Doctor McCollum makes them sick or well, small or large, thin or sleek, contented or ill-tempered. By what may be called improper feeding he can make a rat prematurely old, and by proper feeding can make it retain the characteristics of youth.

These things he has been doing for about 13 years. During this time he has been storing up valuable facts relative to the effects of various foods and animal organisms. These, formulated into general principles regarding human diet, he expects will lead gradually to a longer, healthier life for mankind.

"As a research assistant, the rat is an animal after the experimenter's own heart," he told me. "Gentle, easily handled, and amiable, the rat may be weighed in five seconds. Keeping his record is a simple undertaking. Other factors in his favor are his rapid growth and a generous number of offspring, two points of importance in the study of food consequences. With the rat we are able to carry on what amounts to cross-examination. Giving him food of known elements, we can ask him whether it is satisfactory and demand that he answer 'yes' or 'no.' The animal quickly answers by his growth or his lack of growth.



Dr. Elmer V. McCollum, world-famous authority on food and diet, at work among his rat cages in his unusual laboratory at Johns Hopkins University. In hundreds of experiments with rats, he has learned much concerning the influence of food on the bodily welfare of the animals, which he has translated into terms of the human body. These results have thrown important light on the food requirements of human beings

"In this way the rat is just as accurate as the chemist's beaker, although some chemists are inclined to scorn the use of the animals as lacking the charm of working with crystals and chemical formulae. Call him a laboratory animal or an animal laboratory, as you please, the rat is an ideal fellow scientist."

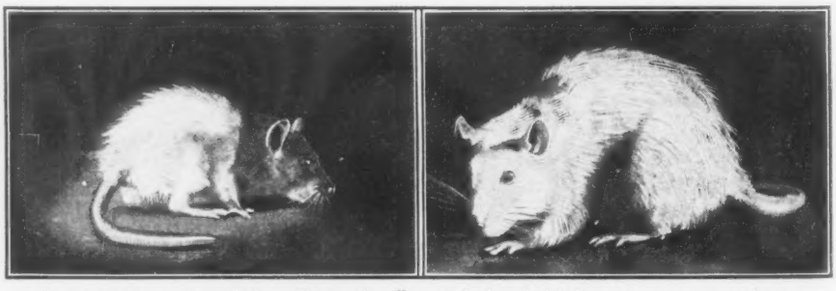
What Diet Does

Some of the physical conditions produced in the rats, simply by regulating their diet, are amazing. Thus a diet containing every element necessary to physical growth except proteins—which man takes mostly from meats—causes a growing rat to become dwarfed. A later change in the diet to include the element formerly lacking will result in growth.

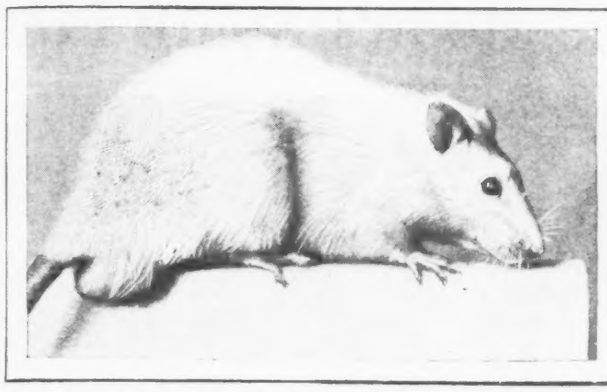
Regulation of the diet will make a female rat barren. It will even destroy the mother instinct and cause the mother rat to attack and kill her young. This is an especially remarkable demonstration of the effect of food on animals, since the mother instinct in rats is very strong.

Departures from the normal diet is found to produce diseases of various sorts—nervous, as well as physical. They also will cause a year-old rat, which should be in prime vigor, to take on the aspect of an aged animal of three years. One experiment that Doctor McCollum has performed repeatedly will suggest an analogy in human life. Two groups of rats of the same age, one fed on an adequate diet, the other on diet insufficient in some particular, apparently will thrive equally for a while. After six months or so, though, the rats insufficiently fed will begin to fail. Nervousness and irritability, bodily emaciation, then death will be their portion, while the other rats will remain plump, strong, bright-eyed, and serene until old age comes upon them.

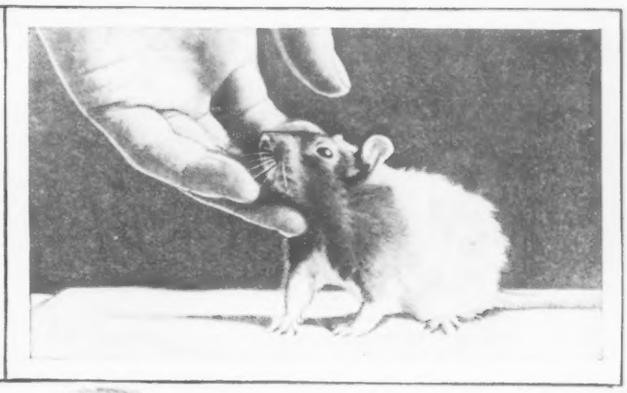
In one cage I noticed a decrepit, gray



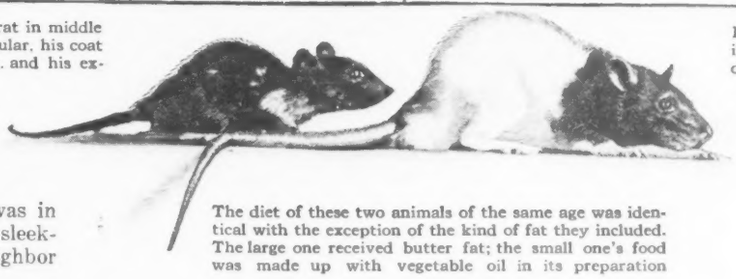
One ingredient—dry whole milk—made all the difference in these two rats, both of which were 308 days old when photographed. In other respects their diet was the same—bolted wheat flour, degerminated cornmeal, cooked and dried potato, peas, navy beans, beets, turnips and beefsteak. The puny, prematurely aged rat at the left lacked the milk diet. The other, receiving the milk, grew much larger, retaining youth and vigor



Above: A well-nourished rat in middle life. He is sleek and muscular, his coat is smooth, his eyes bright, and his expression contented. Animals such as this one never attempt to escape or to bite, says Doctor McCollum



Here is a little bow-legged rat suffering from rickets caused by faulty diet. By experimenting with rats, Doctor McCollum is seeking the cause of rickets, a disease of malnutrition from which 50 to 75 per cent of all children in the world are said to suffer



The diet of these two animals of the same age was identical with the exception of the kind of fat they included. The large one received butter fat; the small one's food was made up with vegetable oil in its preparation

old rat whose senility was in striking contrast to the sleekness and virility of his neighbor in an adjoining cage.

"I suppose you are about to retire this one," I remarked, pointing to the gray rat. "He must be the ancestor of them all."

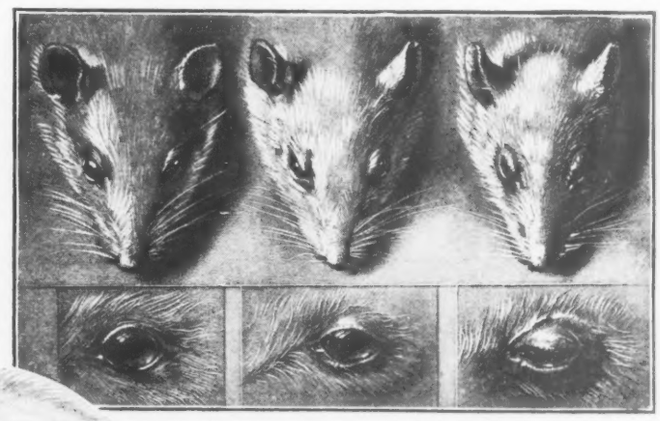
"On the contrary," said Doctor McCollum. "That young-looking rat is a year old and is the father of the ancient-looking rat, which is just four months old."

Here indeed was a striking example of what this remarkable scientist is accomplishing by means of diet!

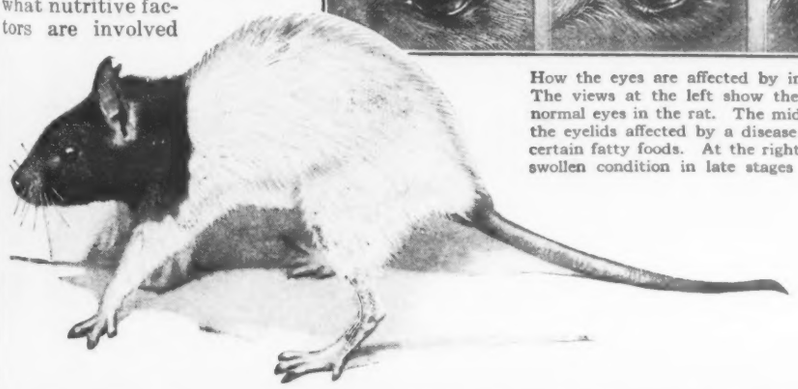
Just now Doctor McCollum, with the cooperation of Dr. P. G. Shipley, is deeply engrossed in the study of bone growth, with particular reference to the prevalence of rickets. This disease of malnutrition is one of the tragedies of childhood. From 50 to 75 per cent of all children are declared to be afflicted, and for this reason a solution of its cause and prevention would become one of the master contributions of research to the human race. The work promises to take years, but the true scientist views such a prospect undismayed—and McCollum is the true scientist.

Some of his most important recent work has been along the line of the relationship of food to the kidneys, in an effort to determine what nutritive factors are involved in the progressive loss of the kidney functions with advancing years. Results place the blame on what the scientist designates as high protein content of the diet, which the rest of the world understands as the eating of too much meat. In this research Doctor McCollum has brought to light much that is new and important.

Doctor McCollum will take a slice of steak, a dish of beans, or a ham sandwich and analyze it to the last atom of its possible effect on the human body. He can glance at the dinner table of his hostess and tell from the food spread before him precisely how much the meal offers in nourishment, energy, and well-being.



How the eyes are affected by insufficient food. The views at the left show the appearance of normal eyes in the rat. The middle views show the eyelids affected by a disease, due to lack of certain fatty foods. At the right are shown the swollen condition in late stages of the disease



This little fellow is showing the first symptoms of a nerve disease called polyneuritis, similar to beri-beri in man, produced by a diet deficient in certain vitamins. Note the tense attitude

As a scientist he is exactness itself. But he does not believe in making the dinner a matter of multiplication and addition—a problem in mathematics.

"It seems useless to me," he said, "to tell the housewife that she must give her family this number of calories and that percentage of various vitamines. It is unfair to expect her to figure that there are 500 calories in a certain steak, 400 in a given amount of liver and bacon, and 300 in a specified weight of spinach. To do this is to expect her to sit down with pencil and paper and figure out for herself by mathematical rule the various dishes that constitute a well-balanced bill of fare.

"In this connection I am convinced that the planning of the meals is of itself a task of which the housekeeper should be relieved by science, and for that reason I have tried to do the work in her stead. In that theory lies the explanation of my book, 'The American Home Diet,' prepared with the collaboration of my associate, Miss Nina Simmonds."

Yearly Bills of Fare

To do away with multiplication, subtraction, and long division in planning meals, Doctor McCollum has given the housewife a bill of fare for three meals a day for every day in the year. The important fact is that he has done all the mathematics in his own laboratory, with the assistance of his rats. These bills of fare are convincing. They show that a scientist may be a human being along with his intimate knowledge of our digestive workshops. This is proved by the readiness with which he prescribes the things we like. His sole aim is to see that we eat these foods in proper proportions. The McCollum bill of fare is not a diet. It is simply a well-balanced ration, seeking to give the proper fuel to the human engine.

Snow-Clad Peaks of the Moon's South Pole

THIS remarkable picture, based on actual astronomical photographs of the South Polar regions of the moon, indicates that the lunar poles, like those of the earth, are covered with snow. At least, that is the theory accepted by most astronomers in explanation of the fact that the poles of the moon are lighter in color than any other regions of its area.

Since the surface gravity of the moon is very weak, water cannot exist there in the liquid state; hence, the inference that it is converted into hoarfrost, ice, and snow is natural.

The geographical position of the pole is marked by the majestic mountain range shown in the background, known as the Leibnitz Mountains. One rises to an altitude of 36,000 feet, or 7000 feet higher than the earth's loftiest mountain—Everest.

This picture is a photograph of a model of the moon's South Pole executed by Scriven Bolton, F.R.A.S.

Why Our Habits Make or Break Us

Another Illuminating Chapter in "The Story of the Mind"

By James J. Walsh, M.D., Sc.D.

ONE of the most significant stories I ever heard was told to me not long ago by a New England manufacturer.

A middle-aged man for several years had been a department head in the shoe factory where he had been employed since boyhood. A new concern offered him an opportunity to take charge of its factory at a generous salary, and he accepted.

His term of service at the plant where he had passed his entire working life came to an end on a Saturday night, and he was to assume his new duties the following Monday morning.

Force of Habit

When Monday morning came, the new manager, who, like most early risers, was accustomed to allow himself no more time than was necessary in getting from his bed to his work, hurried through his breakfast and rushed from his home to the street-car line just as he had been doing for years. The car he usually took was about to start from the corner as he approached. He caught it after a run, found a seat, and became absorbed in his newspaper.

Eventually he got off at a factory building, and hurried within. And not until he saw a stranger sitting at the desk that he had occupied for five years did he realize that, instead of going to his new position, he had walked straight into the factory where he had worked all his life! Not only that, but the street car that had carried him there ran in a direction opposite to the one he should have taken.

When deeply interested, Secretary of the Navy Edwin Denby, presses his tongue between his lips; a mannerism habitual to many persons when paying close attention

Incredible though this story may seem, I find it entirely believable—an extreme case, perhaps, yet a wonderfully illuminating instance of the ruling power of habit in directing the activities of man. That factory manager was so accustomed to going to work at the same time and in the same way every morning that he unconsciously went through the same routine even after he had changed his place of employment.

You, Too!

We are all creatures of habit. You may not realize it, but most of the things you do are the creations of the habits you have formed. You are, in short, what your habits make you. Trivial matters, such as which shoe you put on first; more important things, such as the amount of sleep you take, the quantity of food you eat and the way you perform your work—all of these are the result of habit. Through constant repetition you have so established a particular way of doing things that it has become entirely natural and instinctive, sometimes even involuntary and uncontrollable.

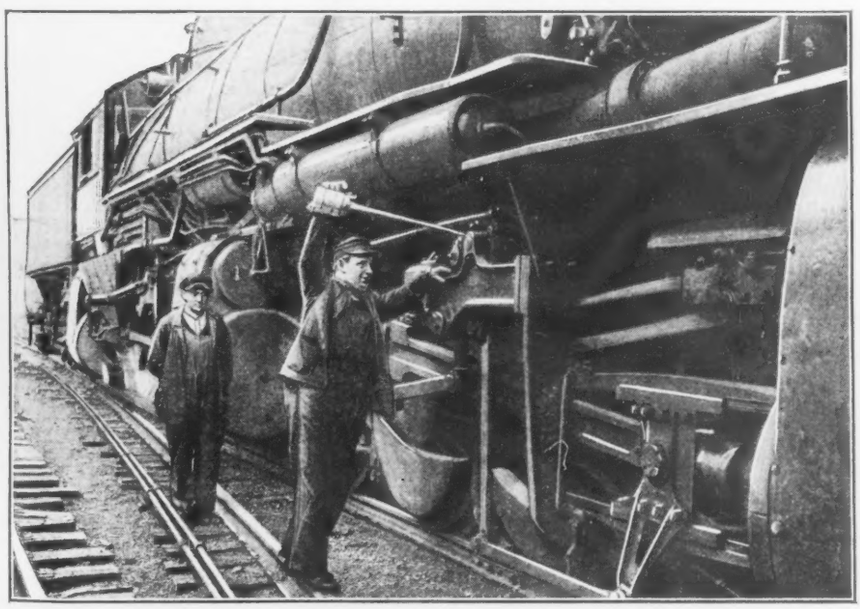
Constant repetition—that is the psychological explanation of habit. And while it is true that habits form your character, you, by constant repetition, can shape those habits for good or bad—for health, success, and happiness, or for failure and misery.

If you are driving a motor car and suddenly find it necessary to stop, you will apply your feet so swiftly to the clutch and brake pedals that your action seems instinctive. It is not instinctive, however. It is performed through habit—through constant repetition. When you first started driving, you will remember, you had to think of each of these movements separately and so performed them slowly.

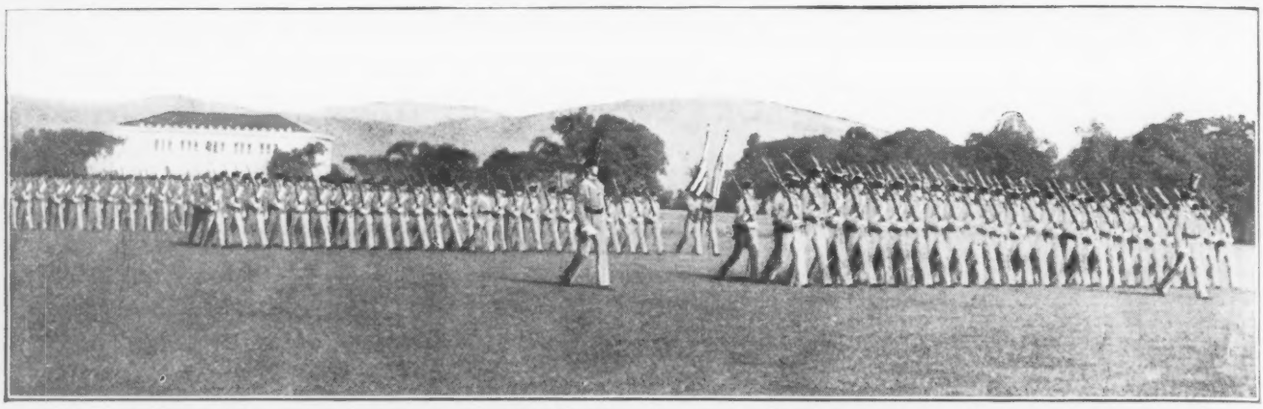
"How Use Doth Breed a Habit"

Even if you are not driving a car—are merely a passenger—habit may lead you to go through the motions of throwing out the clutch and putting on the brakes when the necessity arises for suddenly stopping. I know a motorist who was forced to give up long tours in the summer because of this habit of back seat driving. He always was as tired as his chauffeur at the end of the day's run.

Sometimes habits become so natural that without indulgence in them we feel ill at ease. I could name half a dozen men who actually cannot work unless they have a pipe or a cigar between their lips, even though they may not be smok-



The locomotive engineer has formed the habit of leaping from his cab and oiling the engine as soon as he reaches the end of his run. So firmly is this habit rooted, that the action is performed involuntarily, apparently without conscious effort on the engineer's part



Marching and drilling with marvelous precision, the West Point Cadets are a striking example of the value of habit in successful achievement of the most exacting work. By constant repetition they have formed the habit of always stepping out with the left foot. It has become "second nature" for tall and short men to take steps of the same length to preserve alinement of the ranks. All rifles are held at the same angle. Small points such as these that combine to make the parading companies march as a single, rhythmical unit, were learned at first by painstaking effort. With the trained cadet, they have become unconscious acts. Similarly, Doctor Walsh tells us, profitable habits of health and industry that promote success in any field of endeavor can become so deeply intrenched in us that we shall find it almost impossible to perform an injurious or wasteful act

ing. And I know a lecturer who thrusts his right hand into his trousers pocket the instant he takes the platform, keeping it there throughout his talk. He told me once he would stammer like a schoolboy if he couldn't have his hand in its accustomed place.

What Are Your Habits?

Any number of public speakers have habits of interpolating a syllable like "aa" or saying "ugh" or something of that kind, and when they attempt to break themselves of it, they actually disturb their thinking and their speech. Such is the force of habit.

Such habits in themselves are trivial things perhaps, but they have an important bearing on our daily actions. If you work in a shop or large office, you will observe that every one of your fellow workers starts the day's work and precedes each new task invariably with certain characteristic mannerisms. You yourself undoubtedly traverse the same path every day on your way to your street car, railroad train and office, walking always on the same side of the street, making your crossings at the same points. If you drive an automobile, it is almost certain that you always use the same roads or streets in traveling between two points, even though you may have a choice of other roads equally good. Unless you are unlike most other people, in chewing your food you use the teeth of one side of your mouth much more than those of the other.

Every one of these acquired habits is the result of repetition. The first time you perform an action, you find it difficult. You are awkward, and so it is necessary for you to consider each separate movement carefully before you make it. Each step is accompanied by a rapid-fire, more or less disordered interchange of nerve messages between your senses, your brain, and your muscles. The second time you perform the action, you find it a little easier. There is the same interchange of nerve messages, but it is accomplished more smoothly; you have found out what lines in your bodily telephone system must be kept open for the exchange of messages, and you prevent interference from unnecessary calls.

The third time you essay the action, it is even more easy; the nerve messages travel back and forth with greater speed and surety; the necessity for attention is less. And, when you have done the thing a few more times, the exchange of messages is accomplished automatically, without conscious effort on your part. The action has become a habit—"second nature," as the phenomenon often is expressed. This is a particularly happy way of expressing it, too, in my opinion, since nature so often takes care of us when we cannot take care of ourselves. Our habits—which depend entirely on ourselves—will take care of us if we see to it that they are of the right kind when we are forming them.

It is unfortunate that when habits are mentioned, most people think of bad habits, just as when we talk about passions, people conclude hat evil passions are meant. As a matter of fact, every normal person possesses passions for good so strong that if he follows his natural inclinations, he finds it easier and much more satisfactory to do right than to do wrong.

These passions for good are ingrained in us. They are part of the inheritance of the race, evidence of a world force that makes for good.

Similarly with habits. Habits for good can be so strong that we will find it all but impossible to break away from them and perform an evil action. I do not mean "evil" in a moral sense necessarily. What I mean is this:

Is it your habit always to point with your right hand? You could point with your left hand just as well, but you would not do so unconsciously, as you do with your right through constant repetition

Training Yourself

You can make it a habit to work so industriously that idleness will be irksome and painful to you, with the result that your constant efforts will carry you on to success.

You can make it a habit to eat plain, wholesome food, to chew it thoroughly, to exercise, to bathe frequently, to breathe fresh air and get plenty of sleep, and thereby insure your health.

You can make it a habit to be thrifty and frugal, and so prevent the specter of want from hovering above you in old age.

All of these habits you can acquire through your own efforts and only through your own efforts. Moreover, because your body falls so readily and rapidly into modes of action that become habitual when repeated, the effort required will be less and less as

time goes on. In fact, it is necessary to do no more than to make a good start. After that, Nature carries on the work for you, and at last the habit is ruler and can be broken only by a determined effort.

No principle more useful than this has been developed by the science of psychology. I might almost say that once a man understands the ruling power of habit, he has learned everything of practical value that psychology offers him; that he holds in his hand the key that will unlock the storehouse containing the hidden powers of his mind. For when he reaches the point where habit performs most of his daily routine of activities, his mind is left free to occupy itself with the other more important concerns that will lead him on to greater achievements.

Habit and Instinct

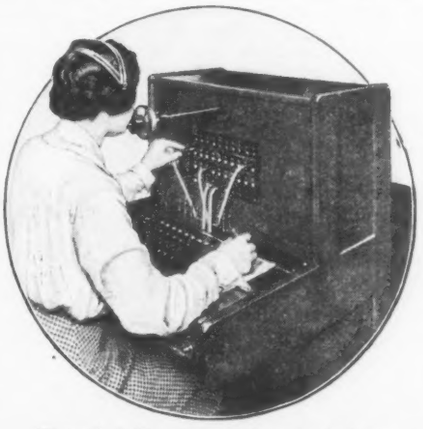
A simple illustration will serve to make clear how habit takes the place of instinct, how it causes the body to perform an action without our being conscious of the guidance of the mind. Undoubtedly there is a flight of steps in your home that you have walked up and down many times. Unless your habit of observation is unusually well developed, you cannot tell me how many steps it contains. Yet you can ascend and descend it in the dark and never fail to know when you are about to step to the upper or lower landing. I do not mean that you can *feel* the landing when your foot touches it, but that, when you reach the last step, you know—seemingly by instinct—that you are about to step from the stairway.

This is not instinct, though; it is the result of habit. Although you cannot state the precise number of steps in the stairway, your mind knows from previous experience exactly how many there are, and so accurately guides your muscles in carrying you up or down. It is possible even for you to carry on a conversation with some one while walking up a familiar flight of stairs in the dark, and, though you may be giving full attention to your talk, habit will guide you safely to the top.

A few minutes after you have gone to bed at night you cannot recall having wound your watch, yet, if it is your habit to do so upon retiring, it is almost certain that you will find you have done so if you get up to investigate.

An example of the strength with which habits take hold and the difficulty with which they are broken is furnished to all of us who live in places where "daylight saving" is put in force during the summer. When the period begins, we suffer acute hardship getting up an hour earlier in the morning, and we find it difficult to go to sleep immediately when we go to bed. When it ends, we find ourselves for a time waking up too early in the morning and becoming drowsy at night before what, according to the clock, is our bedtime.

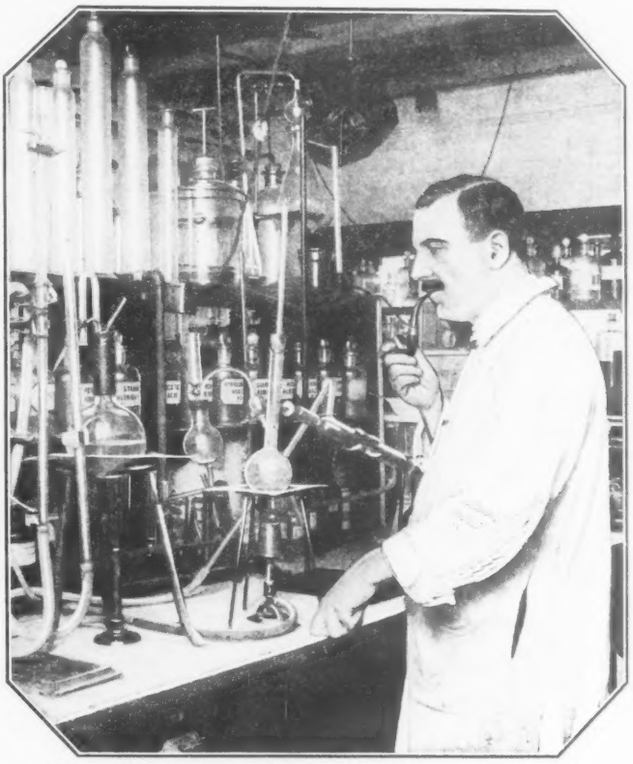
Change of environment likewise upsets our habitual routine. People who do little traveling are restless in hotel beds or sleeping-car berths, while experienced travelers sleep peacefully, no matter what their changed environment may be.



Through habit, the experienced telephone switchboard operator reaches instantly for the right plug when she hears a certain number or name in the telephone receiver

City dwellers are not aware that they hear the rumble of traffic and the roar of street cars—sounds that are all but agonizing to the visitor from the country. Similarly, city people are acutely aware of the noises made by insects and animals, the rustle of trees and similar sounds peculiar to the rural districts, while country people never will notice these sounds unless their attention is specifically called to them. All of these are examples of the amazing force of habit.

Take pencil and paper and try to copy a simple drawing, say the head of one of the characters in a newspaper comic strip. You find it difficult, even if you have had some practice in drawing. You must stop again and again to refer from the model to your drawing. Yet you can write a long letter without ever giving a thought to the manual dexterity required in forming the letters, which are quite as complicated as the lines that make up a single comic drawing. Habit is the explanation.



This chemist is typical of the man who finds it quite impossible to do his best work unless he has a pipe or cigar between his lips. He probably is quite unconscious of the fact that he is pulling on his pipe. His whole attention is concentrated on his experiment; yet habit causes him to perform all the actions incidental to smoking. How many times have you caught yourself pulling on a cold pipe?

Marks of Individuality

The acquisition of a habit may be compared with the uncomfortable process known as "breaking in" a new pair of shoes. It is painful at first, but there comes a time when the habit, like the shoes, becomes set to our conformation. Like old shoes, we wear the habit without ever being aware that we have it on.

Habits actually become so much a part of an individual that in the case of well-known men the habit often is an identifying mark, quite as much as are facial and other physical characteristics. "Uncle Joe" Cannon, late Speaker of the House of Representatives, had the habit of smoking long cigars. Through thousands of photographs and cartoons published during his long public career, this habit was so well exploited that most people probably would have failed to recognize a likeness of him without the inevitable cigar.

Everybody knows that the enormous amount of work Edison has accomplished is traceable largely to the habit he acquired early in life of getting along with very little sleep. When Clemenceau, the "Tiger of France," visited the United States a few years ago, the reason for his marvelous vigor at an advanced age was revealed in his regular and abstemious habits.

Woodrow Wilson His Own Typist

While Woodrow Wilson was President, his custom of writing important speeches and documents in shorthand or on his own typewriter was commented on frequently. Though he had secretarial and stenographic aid at his call, nevertheless the habit of years persisted—he thought most clearly when he himself performed the mechanical work incidental to composition.

The late Professor William James, noted psychologist of Harvard University, likened a habit to a groove in the nervous system, down which impulses flow, making the groove ever deeper so that the im-

(*Continued on page 152*)

Mechanics, My Aid in the Wilds

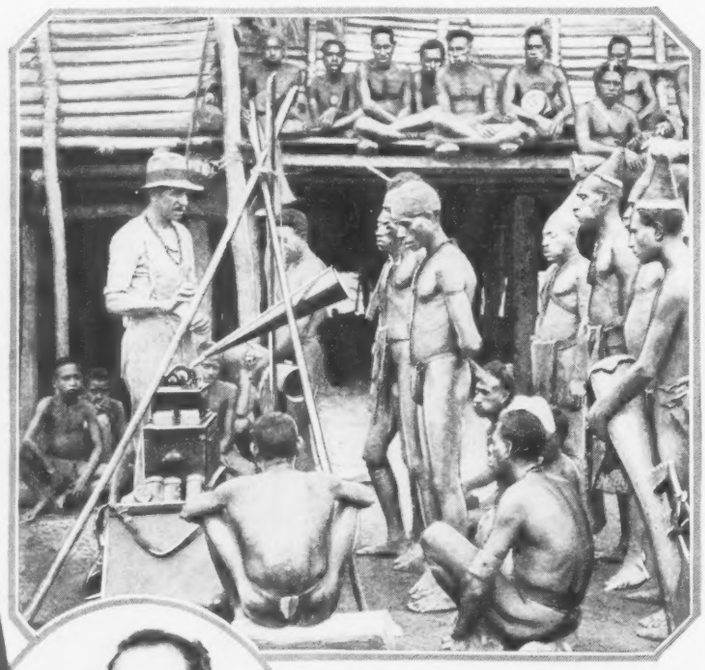
By Captain Frank Hurley

World Famous Explorer, Discoverer of the Lost Tribe of New Guinea

IN THE imaginative hours of impetuous childhood, who has not been fired with the soul-stirring desire to become a carefree buccaneer?

Thus it was in my early life, even though the years were wrought in the hard school of iron, and tempered by poverty.

To gain a sound fundamental knowledge of mechanics, to be master of metal, this was to be my chosen occupation. So for five years I labored, the day at the lathe, the evening at college. Later I devoted four arduous years to the study of photography. Little did I ever imagine that the wild fancies of childhood ultimately would rise supreme and subvert my engineering plans for the future.



Science and art meet in the jungle. Captain Hurley is shown above making phonograph records of primitive native songs of the "lost tribe" in New Guinea. A theme from one of these weird chants has been elaborated into a "jazz" tune to be published soon. Note the strange musical instrument held by the savage head-hunter at the extreme right

At the left is Captain Hurley, fearless explorer, holding a boomerang that he brought back with him from his explorations in New Guinea

An Opportunity

Yet what a dominant part those years of practical application were to play in the ultimate success of the many hazardous enterprises upon which my primitive romancings launched me!

The golden opportunity came while Sir Douglas Mawson was manning an Australian expedition to explore the antarctic regions, and every shoulder that carried a camera joined in competition. Though the chances were at least 1000 to one against me, I was chosen simply because I had photographic skill and a solid backing of practical mechanics.

When I turned southward to the regions of eternal ice, my chest of tools included as careful and complete a selection as my battery of lenses. The expedition's personnel was chosen from the "Don" graduates of Australian universities, highly trained in theory—men to the core—but in mechanical practice quite deficient. I shall never forget the rude yet amusing experiences of those first antarctic days when the scientists unscientifically erected our winter quarters hut.

I remember Dr. Xavier Mertz, ice expert, sitting straddlewise the ridge cap, enthusiastically banging at nail heads, but more often hitting his finger nails. Inside the house the learned bacteriologist, Dr. Archie McLean, with equal ardor, was tacking on the light ceiling boards directly underneath, using four-inch nails. A wild yell and Mertz leaped, slid precipitately down the sloping roof, clutched wildly at the stay supporting the kitchen chimney, and dove headlong into a snow bank carrying the smoking stack with him. Closer investigation of the cause disclosed an inch of piercing nail bristling through the roof from whence the punctured Mertz had so hurriedly risen.

Antarctic Inventions

Cut off from the world for more than a year, we were thrown entirely on our own devices and resources. The frigid conditions necessitated alterations in my cameras and the making of special developing appliances with warm-water circulators. In addition, various scientific instruments and wireless equipment demanded ceaseless attention, so the mechanic became a very important man. I even added to the expedition's store of scientific apparatus by fashioning from odds and ends various instruments for meteorological observation.

One of these I called the "blizzard detector." It consisted of a metal ball mounted on a mast above our hut, insulated from the ground and connected with a simple gold leaf electroscope inside the hut. Atmospheric electricity generated by a snowfall was taken up by the ball and traveled to the electroscope, which was connected through a relay with an electric bell circuit. When the electroscope was charged, its movement closed the circuit that operated the bell, and the snow alarm rang out. This contrivance proved most efficient, so much so that one of the party, after being awakened by it a half-dozen times one snowy night, hurled a boot at it and finished it.

Alarm Clock Wind Detector

I also made a machine for detecting the velocity of the wind, which averaged 49.9 miles an hour during our stay, reaching at one time a velocity of 214 miles. An alarm clock served as the basis of this instrument. The hour hand of the clock caused a dial of smoked paper to describe a complete revolution once a day. Against this dial was placed a pointer, balanced by a spring and connected

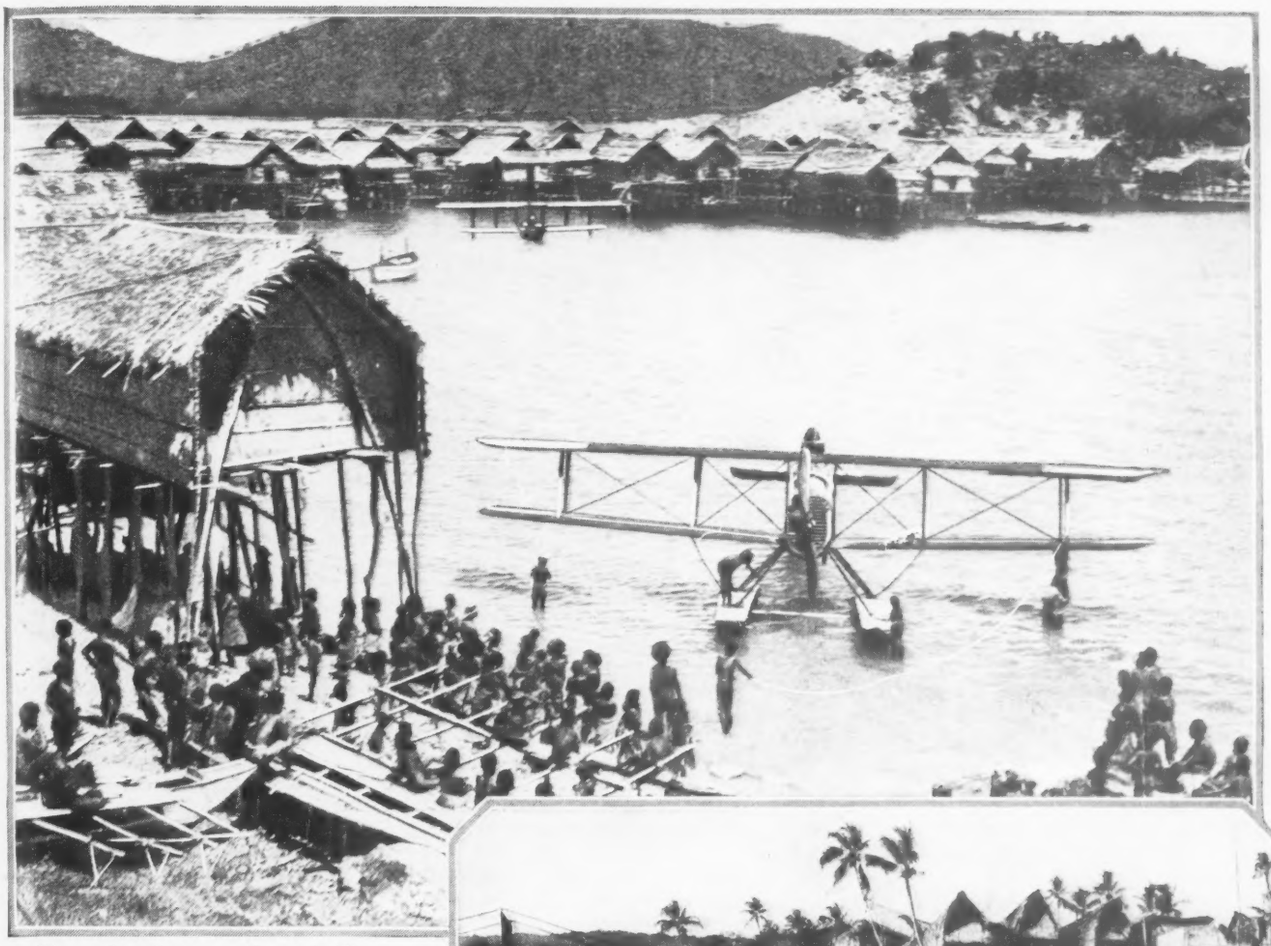
He Made His Own Way

"FIND a way, or make one!" is Capt. Frank Hurley's apt summing up of the secret of achievement—advice based on the experiences of his own remarkable career of adventure.

Twenty years ago a poor boy in Australia, he has made his way successively as machinist, engineer, photographer, war hero, explorer, and writer. Now, at the age of 34, he finds the eyes of the whole world focused on him as a result of his discovery of a lost savage tribe in the jungles of New Guinea, territory never previously explored by a white man.

Captain Hurley was official photographer to the late Sir Ernest Shackleton's South Polar expedition. He has taken part in other polar explorations and is now planning another trip into the antarctic. He has explored Australia's unknown territory by automobile, being possibly the first man to use a motor car in prosecuting an exploration.

His own story of how his mechanical skill, acquired in boyhood, carried him safely through the most desperate situations, is an inspiring chronicle, bound to stir the blood and to stimulate the spirit of every lover of adventure.



The explorers' two seaplanes, landing where neither white man nor his winged machines ever had been seen, filled the New Guinea head-hunters with superstitious awe. After much persuasion they were induced to approach the planes

with a celluloid ball, hung on a long horizontal wire. As the wind moved this ball, the movement was transmitted along the wire to the pointer, which scratched the smoked surface of the dial. Photographs of the curves scratched on the dials supplied us with accurate wind records.

More for amusement than anything else, I constructed a sled driven by a wind motor. A wind wheel mounted on a turret turned through a system of worm gearing two spiked wheels beside the runners. As the spikes sank in the snow, the sled moved forward. By setting the fan according to the direction of the wind, it was possible to steer the sled, to travel with the wind, against it, or at an angle to its force.

The manufacture of these devices gave me my first experience in utilizing scraps for the fashioning of useful articles, an experience that proved invaluable on later expeditions, for it literally saved my own life and the lives of others and carried my companions and me safely through several dangerous emergencies.

The Mawson expedition paved the way to others—the East Indies, a second antarctic cruise and finally a small venture of my own, when I joined forces with Francis Birtles, another Australian explorer. In two "flivvers" we left Sydney on a 10,000-mile "joy ride" through Australia's unknown, venturing on wheels among the primitive aboriginals. Had it not been for our mechanical initiative—Birtles had also served his time in iron—the journey never could have been accomplished. Little other than the essential working parts of the "flivvers" remained upon our return, and these displayed many crude thermite weldings, and

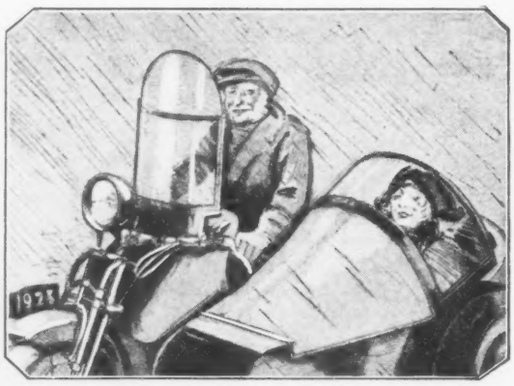
(*Continued on page 153*)

The natives believed the white men were gods and their aircraft huge voracious birds that would attack them unless appeased. Each night, as the flying boats lay at anchor, the savage head-hunters brought pigs to satisfy the appetites of the terrifying visitors from the skies. One of the pigs is shown above lying across the bow of the plane. The explorers were careful to remove the pig before morning, so that the natives would believe the winged monster had devoured it. At the left is the light draft vessel used by Captain Hurley as a seaplane tender. Its wireless equipment guided the planes in their explorations over the jungles and made possible speedy location of the machines

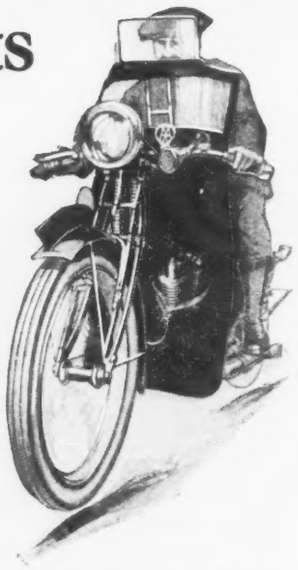
New Motorcycle Comforts

All-Weather Shields Protect Riders Snugly

Face and body shields for the driver; side curtains and top for the sidecar give protection to the riders in stormy weather



Rain, wind, or snow hold fewer discomforts for motorcycle riders with the development of ingenious shielding devices that are transforming the breezy cycle and sidecar into a comfortable, all-weather vehicle



This apron, attached to the frame, is surmounted by a celluloid window and face shield

By Newton Burke

RECENT developments in the design of motorcycles indicate that the problem of protecting riders from the wind, rain, and snow of winter—a problem that has engaged the attention of designers since the use of the machines became general—is about to be solved.

The sidecar already has been made snug and weatherproof. Now the comfort of the man in the saddle is being provided for.

American engineers are watching with interest a new development that is expected to do much toward making the motorcycle an all-weather conveyance. This is a design by French engineers that would inclose the rider in a cab, providing freedom of movement and clearness of vision without the usual exposure to the weather.

Light Frame Holds Hinged Top

A light metal frame, streamlined, would be attached to the frame of the motorcycle in such fashion that the handlebars and front wheel could be turned at any angle within the body. A large celluloid window would give the driver clear vision, at the same time extending far enough above his head to deflect all wind and rain beating from the front.

Should rain come at such an angle that it would strike him in the back, he could unfold a hinged top that would fasten to the frame and cover him, thus inclosing him in a cab. The sides then would be left partly open to allow arm signals. Wide, curved leg shields would protect the rider from beneath, and side plates would cover the engine. A slight extension of the exhaust would permit gases to pass out from the inclosure.

One of the first face guards — an apron belted about the driver's waist, supplemented by a celluloid window extending to the top of his head

The practicability of such a design is conceded by American engineers.

"There is absolutely no reason why such a shield cannot be designed," said one motorcycle authority. "If the French engineers have succeeded in overcoming the difficulties that others have experienced, they will have accomplished an improvement that should find considerable use, especially in Europe, where the motorcycle finds wider application than in America. Any practical device that will add to the comfort of a motorcycle rider will be welcomed where motorcycles are used for service as well as for sport."

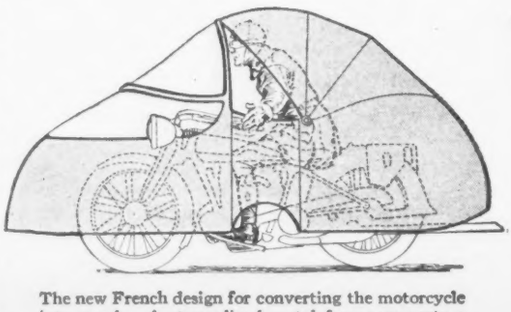
While the design of the French engineers is radical in that it proposes to inclose the whole body of the rider, it follows along the recent advances made by American engineers in developing protective devices. The first of these was a top and side shield that converted the sidecar into a closed cab. Next, designers undertook to protect the driver from rain and mud by shoe and leg guards, some types of which covered the legs entirely. But this left the face without protection.

One early and effective face guard was an apron belted about the waist of the driver and with a celluloid shield extending upward to the top of the driver's head. It was held at a comfortable distance from the face by arms extending from shoulder straps. The apron curved slightly, to reduce wind resistance, and served to keep water from running down on the cyclist's trousers.

Another shield fastens to the frame of the machine. An apron extends downward from the handlebars to a point below the level of the wheel hub, protecting the legs from splashed mud and water. The upper portion above the handlebars has a curved window of celluloid. Above this is mounted a movable window to which may be fastened an automobile windshield wiper. Since this shield is curved and tilted slightly back toward the cyclist, the wind resistance is practically negligible. The protective device is attached to the frame in such a way as to avoid any interference with the control and operation of the machine.

Motorcycle Development Is Rapid

The transformation of the motorcycle from a motorized bicycle to the highly efficient vehicle has been rapid, from a mechanical viewpoint; but in the matter of comfort for the driver and passenger the advance has not been so marked. However, with engineers here and abroad working on the problem, the transformation of the breezy, two-wheeled speedster into a comfortable, all-weather conveyance appears to be in sight.



The new French design for converting the motorcycle into a cab. A streamlined metal frame supports a hinged hood that can be lowered about the rider

Leg guards and a protective shield for the motor are improvements in weatherproofing

Are You a Physical Spendthrift?

Science Explains the Tired Business Man; Overtaxed Bodies Go Bankrupt

By **Reynold A. Spaeth, Ph.D.**

Associate Professor of Physiology, School of Hygiene and Public Health, Johns Hopkins University

Conquering exhaustion by the deep-seated urge for self-preservation, Alain J. Gerbault, French sportsman, recently crossed the Atlantic Ocean alone in a 30-foot sailboat, completing the voyage in 142 days. He is shown above in his boat at the end of his record-making trip. His achievement is a striking example of how all of us, under the stress of necessity, can tap unsuspected resources of energy to perform surprising feats. For him collapse meant death

SOME people seem to be born tired. Yet we may assume that the average adult starts in to work in a normal, rested condition. He begins his career with a sort of capital, a physiological capital, which he can spend recklessly or carefully just as if it were capital in the form of money.

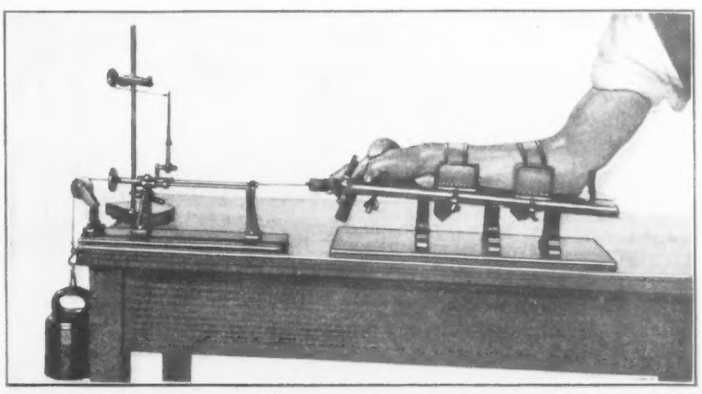
When a man works, he draws on his physiological capital; when he rests and eats, his account is balanced, his energy is restored. Normally, we go through life alternately spending and saving. The harder we work the more physiological capital we spend and the more we have to rest to balance our physiological account. The man who overworks continuously with little rest is a spendthrift. Sooner or later he becomes physiologically bankrupt.

Now the fatigue produced by any specific job, say lifting five-pound packages from the floor to a shelf, depends not only on the weight to be raised, but also on the rate at which the work is done. If I lift two five-pound packages a minute, I can stay on the job almost indefinitely; but if I have to lift 20 packages a minute, I peter out in a relatively short time.

Ration Out Rest and Work

At two packages a minute I am constantly returning to my original level of physiological capital; at 20 a minute I cannot rest enough between packages to hold the pace. In other words, for any unit of work there is a corresponding time-unit of rest that will exactly and completely restore the muscles to their original working level. It is failure to regulate work to this proper speed that causes undue fatigue.

An expert bricklayer who has found his stride can lay a given amount of bricks each day without being fatigued in the evening. But let him try to hurry the job and what happens? For the first few hours he may do much more work than usual, but along in the afternoon he begins to get tired and his work slows up. By evening he has become so much slower that the net result of his day's work probably will be that he has accomplished less and is more tired than on ordinary days. His work-rest relation has been upset and his working capacity impaired.



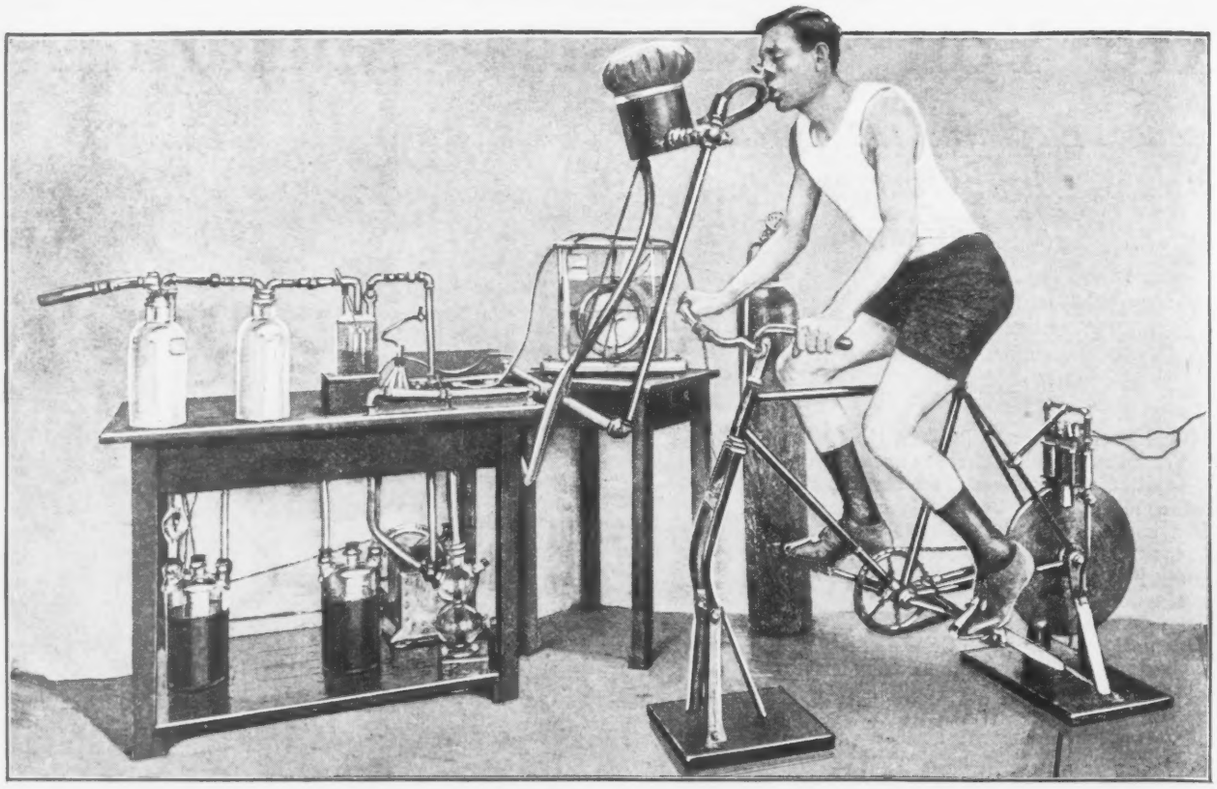
The ergograph—an apparatus used by Doctor Spaeth in his laboratory at Johns Hopkins University to measure the amount of work performed by students and to test their fatigue. The work consists of lifting an eight-pound weight with one finger at stated intervals, with prearranged rest periods

The heart is probably the best illustration of this work-rest relation. Between beats the heart rests just enough to prepare for the beat that is to follow and to overcome the fatigue of the previous beat. Through centuries of trial and error, the heart finally has settled to a rate of work that keeps it going for from 70 to 100 years. It never gets bored with its work.

The entire human being, in contrast to the heart, is anything but a machine. Man is a willing or an unwilling, a hating, desiring, pleasure-seeking animal. We cannot set him going like a machine, knowing that he will still be running when we return. We must urge him artificially, by various incentives, to stick to his job.

In heavy manual labor, rest periods are particularly effective in protecting men against undue fatigue. But even in work that is merely monotonous or exacting, rest periods may do wonders. In an experiment that I carried out on a group of skirt pressers, two rest periods of five minutes each at 10 a.m. and 3 p.m. gave an average increase in production of more than 20 per cent. No physiological theory of calory consumption could account for such an astounding increase in efficiency. The effect was obviously psychological.

We might suppose that a man's working capacity is a stationary thing; that under any and all circumstances he is able to do the same amount of work, provided only that he has enough rest. This certainly is not true. We all know that under the stress of emotional stimulation we may perform really astonishing physical feats. The man who is chased by a bull and scales a fence at the other end of the field probably could not repeat his performance without the bull's help. After assassinating Lincoln, Booth broke his leg, but he was able, none the less, to drag himself to his horse and escape. Excitement and the deep-seated urge for self-preservation made available sources of



This strange apparatus is employed at the Carnegie laboratory in Boston, Mass., in experiments to measure the physical energy expended in performing any specified amount of work. Here the work consists of pedaling a friction wheel of a specified load. As he pedals, the rider exhales through his mouth into a tube that carries his breath to experimental test tubes and retorts. Meanwhile his nostrils are closed tightly by pincers to prevent escape of his breath into the air. The amount of carbon dioxid he exhales determines the amount of energy he consumes in the work. Since the work and the exhalations both are measured accurately, the relation of one to the other is a measurement of the rider's physical fatigue. It determines the amount of work required to exhaust this bodily energy

energy that ordinarily he could never have tapped.

Alain J. Gerbault, a French sportsman, who recently crossed the Atlantic Ocean alone in a 30-foot boat, making the trip in 142 days, rather remarkably demonstrated this. At times, according to his own story, he was almost exhausted from lack of food and sleep, but to collapse would have meant death. Therefore, under the force of necessity, he tapped sources of energy he had never called upon before and managed to pull through. On his arrival in the United States he spent 18 hours in bed and then apparently was as fresh as ever.

Consider how you yourself respond to music. If the orchestra is good and especially if you enjoy the rhythm of the tune, you will dance far into the morning without unpleasant consequences. If you had to spend the same amount of energy removing ashes from the furnace or darning socks, the job would seem interminable. Work measured by ordinary performance gives us no idea whatever of what we might accomplish if only the incentive were strong enough.

The Human Engine

It has long been known that the energy consumed in muscular work is derived mainly from carbohydrates (starches and sugar), stored in the form of glycogen in the liver. Normally this fuel, in the form of sugar, is released into the blood in small amounts, carried to the muscles and there burned up much in the manner of an automatic feed furnace.

Professor W. B. Cannon, of Harvard University, and his students found that under the stress of excitement or emotion there is set free in the blood a secretion from a pair of small glands near the kidneys (the adrenal bodies), which speeds up the sugar-releasing machinery of the liver and enables all of us, under stress, to accomplish surprising feats.

Excitement, fear, pain, or rage, all set the sugar machinery going. If the emotional disturbance is a false alarm, calling for no muscular activity, the excess sugar is excreted in the urine and the normal sugar balance is restored. Doctor Cannon once tested the urine of a number of substitutes who sat on the side lines at a Harvard-Yale game. Five of these men showed sugar. Merely watching the game and anticipating taking part in it was enough to set the physiological preparedness machinery in motion. An excited spectator who was examined also gave a positive sugar test.

Excitement does more than affect merely the sugar supply to the muscles. Through the stimulation of the sympathetic portion of the involuntary nervous system, the pulse is quickened, the blood pressure rises, and there is a redistribution of blood from the stomach and intestines to the arms and legs, where the muscular work of fleeing or fighting is concentrated. Thus all the physiological changes that accompany excitement are preparation for sudden and intense action.

The value of such changes to an animal in its struggle for existence are obvious. The value to human beings becomes evident when we consider that even for civilized man emergencies arise that can be met only by terrific bursts of physical energy.

The Mental Factor

Another and very subtle factor markedly affects our working capacity. I refer to our mental attitude toward the job. A simple laboratory experiment will make this point clear. In my laboratory I have an apparatus with which I can measure the

(*Continued on page 155*)

You Can't Cheat Fatigue

YOU can't borrow from yourself without paying back if you would maintain your solvency. This is true of your physical capital as well as of your financial reserve, as any physiological credit man would tell you.

In this article Doctor Spaeth tells how the physiological spendthrift brings himself to bodily bankruptcy by borrowing on his reserve without making replacements, and how fatigue finally collects its debt.

Doctor Spaeth is dealing with facts, not theories. The facts were determined by careful experiment and they have a vital bearing on *your* every-day life. Read what he has to say and then check up your own bodily capital. It may save you from physical bankruptcy.

Maude Adams as an Inventor

Beloved "Chanticler" of the Stage Perfects Radical New Process of Daylight Movies

Maude Adams as "Chanticler"

© Charles Frohman

By Truman Stevens

WHILE sweeping improvements have been made in motion pictures since the days when they were merely a scientific curiosity, in one or two vital particulars the movies until now have remained unchanged. One of these has been the necessity of exhibiting them in a darkened theater. Another has been the failure of the usual black and white tones of the images projected on the screen to create more than an imperfect illusion of the living quality in the scenes depicted.

Recently, though, came an announcement of tremendous interest to all motion-picture patrons. A process, it was said, had been perfected to show moving pictures not only in broad daylight, but in full natural color. The color effects were to be produced not through artificial tinting, staining of the film, nor by means of color filters, but by a direct method of color photography.

Actress Becomes Inventive Genius

The most amazing phase of this announcement, perhaps, is the fact that the new daylight color movie process has been developed by a person who never had been associated in the public mind with any sort of scientific or inventive work. The inventor is Maude Adams, who, when she retired from the stage five years ago, was America's best loved actress, famous for her "Peter Pan," for her "Chanticler," and for a long list of other parts that had made her the idol of theater goers.

Miss Adams conducted her researches and experiments in special laboratories provided for her at the plants of the General Electric Company in Schenectady, N. Y., and of the Eastman Kodak Company in Rochester, N. Y. The details of the process she is said to have perfected are being kept secret.

The announcement regarding her method of projecting pictures in daylight is limited to the statement that it depends on a non-actinic light that she has developed; that is, a light lacking the chemically active properties of ordinary sunlight or ordinary artificial light. That her inventions have been brought to a practical stage of development, though, is indicated by the fact that a photo play, in which the new processes will be used already is in the making.

Colored moving pictures have been produced by various processes and with varying success since the early days of the industry. One method, dating back a score of years and still in use, consists of applying paints or tints to the film by hand, a long and tedious process. In other processes ingenious use has been made of the principle on which color-plate printing depends—namely, that by blending two or more of the primary colors an illusion of natural color may be obtained.

One method popular several years ago depended for its success on the rapid revolution of alternate filters of red and green in front of the film in projection. The blending of these colors in the projected images created an impression of colored photography.

About a year ago Dr. Daniel Frost Comstock, of Boston, Mass., perfected another ingenious color process. In this only red-orange and blue-green rays were permitted to reach the film. The individual exposures were alternate blue-green and red-orange impressions, though the film showed only black and white. In printing, the images were superimposed. Then the film was dyed, the blue-green images taking blue-green dye and the red-orange images, red-orange dye. When the film was projected, the eye saw the pictures apparently in their natural shades.

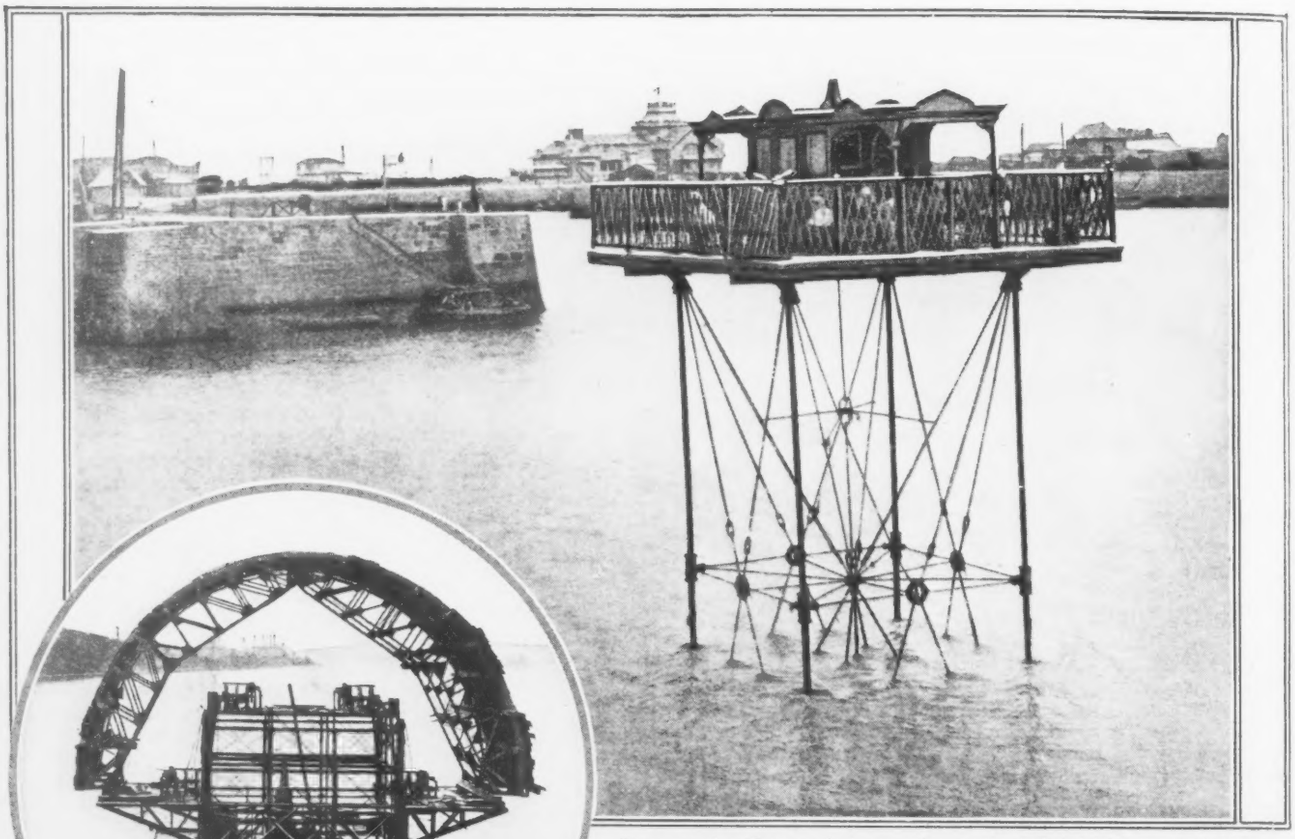
Devotes Her Life to Science

It is said that Miss Adams' method not only is revolutionary, but is entirely original in conception. It is, in fact, the result of years of study and research.

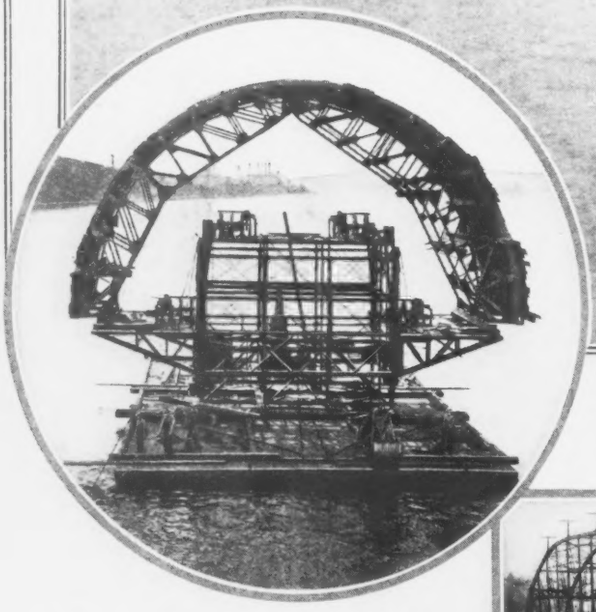
While Miss Adams was on the stage, it is said, her chief interest, aside from her art, lay in the technical details of stage lighting. To her, the electrician of her company always was a most important member of the organization, and she spent every available moment discussing with him the various phases of theater illumination and devising new lighting effects. And during all this time she was keeping pace with the new developments in the science of lighting.

For the last five years she has literally lived in the laboratories prepared for her at Schenectady and at Rochester. Not even Edison, when he was developing the incandescent light, labored more ceaselessly than she in bringing about this new development in illumination. Her retirement was as complete as if she had entered a convent. Indeed, until the recent announcement of her work, many of her admirers assumed that it was to a convent she had gone. It was not to religion however, but to science that she had decided to devote her life.

World Wonders in Bridge Building

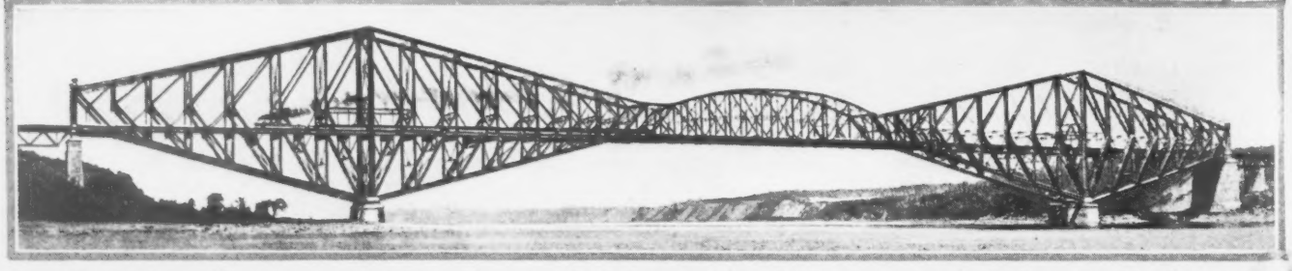


Because the distance between the ports of Saint-Malo and Saint-Servan, on the north coast of Brittany, made the building of a bridge span too expensive, the unusual moving bridge shown above was devised. It runs on rails at the bottom of the harbor, and is hauled through the water from one port to the other by a cable

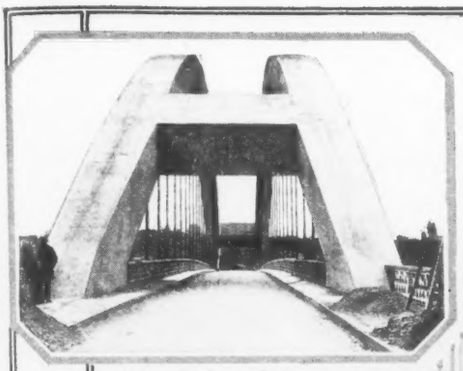


Engineers who built the new Philadelphia & Reading railroad bridge across the Susquehanna River at Harrisburg, Pa., saved thousands of dollars and several weeks of labor by the ingenious expedient of floating the central arch on a barge down the river, and into its position

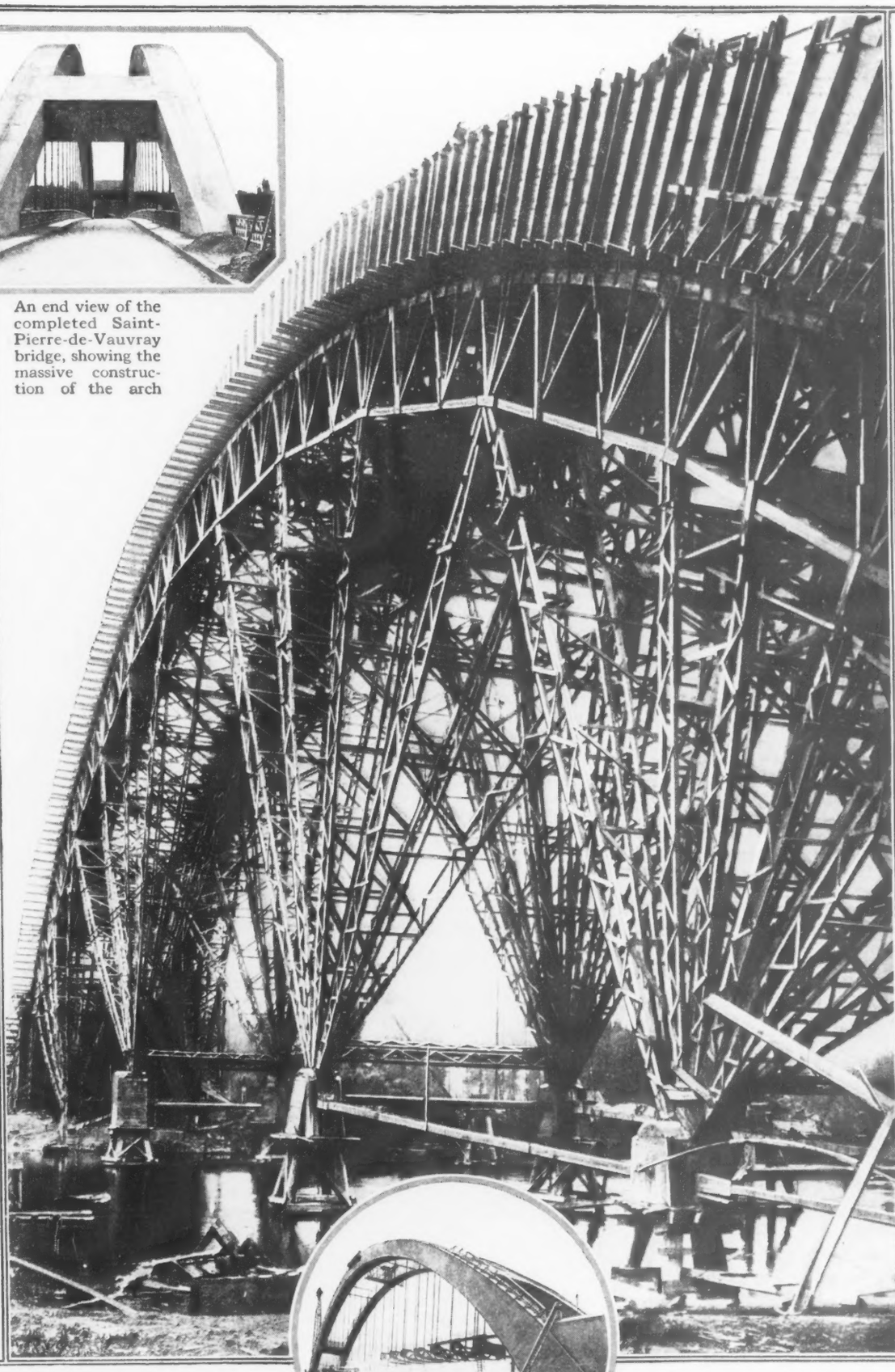
At the right is shown the odd spiral bridge spanning the Mississippi River at Hastings, Minn. Since the height of the bridge necessitated an extraordinarily long approach, this approach was built in a spiral to give access to the town's waterfront



One of the world's greatest engineering achievements is the huge cantilever bridge that spans the St. Lawrence 10 miles up the river from old Quebec. The length of the span, the longest ever built, is 1900 feet; distance between piers 1800 feet



An end view of the completed Saint-Pierre-de-Vauvray bridge, showing the massive construction of the arch



This single-arch, reinforced-concrete bridge across the Seine at Saint-Pierre-de-Vauvray, France, is said to be the greatest structure of its kind. It was officially opened a few weeks ago by President Millerand. Insets show the bridge during construction and complete

The large picture above shows the huge concrete arch during construction. It is 433 feet long and 114 feet high. Note the steel supporting structure, which later was removed by unusual engineering methods, the arch supporting its own weight as well as that of the span

New Mercury Boiler to Save Fuel

Revolutionary Power System Offers the Possibility of Cheaper Electricity for Our Homes and Factories

By Donald Harris

A NEW era of cheaper electric power and light for homes and factories is foreseen by engineers in the announcement of the successful development of a revolutionary mercury boiler which, in generating metal vapor instead of steam, promises to make one ton of coal do the work of two and to effect a tremendous saving in the world's fuel supply.

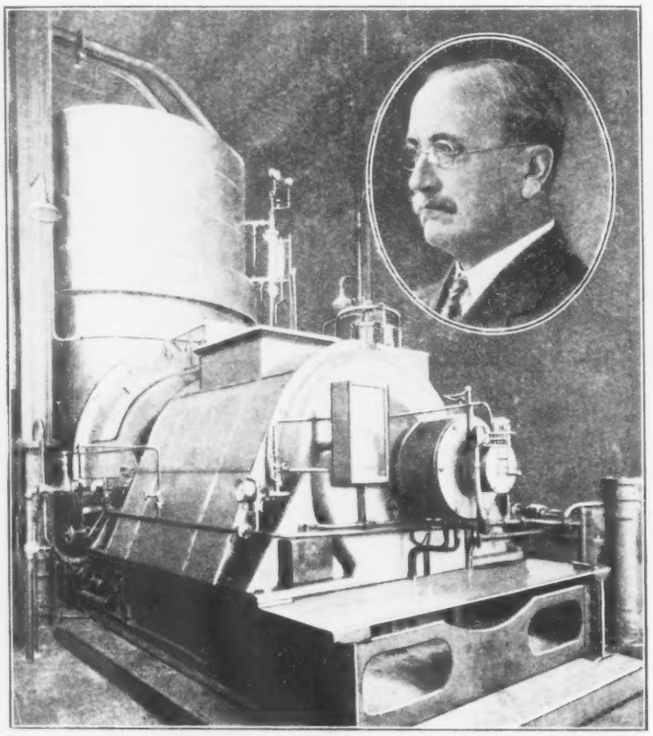
Successful Tests

The boiler is the invention of William LeRoy Emmet, consulting engineer of the General Electric Company. While it has not reached a stage of development where it can be applied generally for commercial purposes, yet in actual tests at the plant of the Hartford Electric Light Company at Hartford, Conn., it is reported to have developed 50 per cent more electric power than that produced by a steam generating plant using the same amount of fuel.

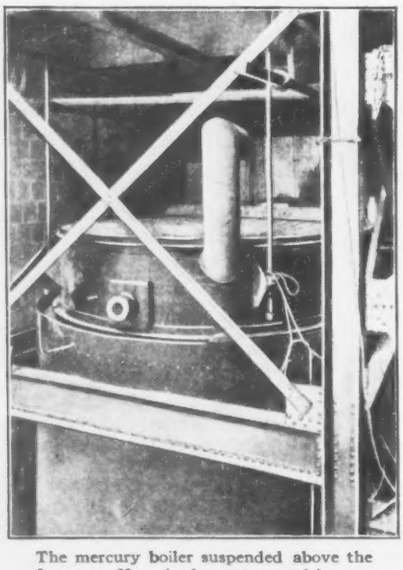
As the result of these tests, the advantages of the new power unit, in addition to the tremendous saving in fuel, are announced by the inventor as follows:

Its installation in a power house requires no radical changes in apparatus other than the substitution of a mercury boiler for the steam boiler.

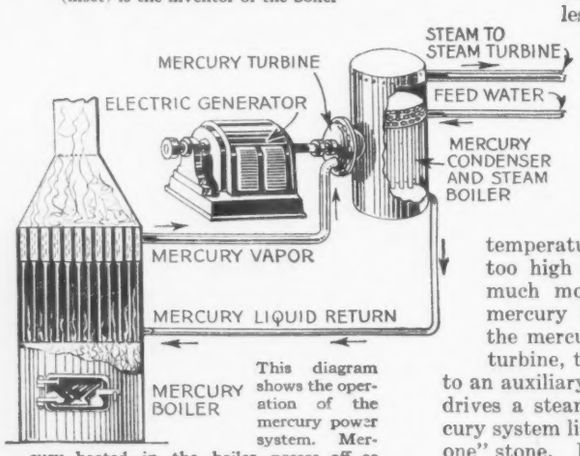
The mercury is used over and over again in the vaporizing system without appreciable loss and without the necessity of replenishment. Since all joints are welded to prevent escape of mercury vapor, there is no danger to workmen from mercurial poisoning.



Installation of the new mercury vapor power unit at one of the plants of the Hartford Electric Light Company, Hartford, Conn., showing the generator in the foreground and the cylindrical mercury vapor condenser at the rear. William LeRoy Emmet (inset) is the inventor of the boiler



The mercury boiler suspended above the furnace. Vaporized mercury drives a turbine, then gives heat to generate steam



This diagram shows the operation of the mercury power system. Mercury heated in the boiler passes off as vapor. This is carried through a pipe to drive a turbine, which runs an electric generator. Exhaust mercury vapor then passes from the turbine to the condenser, into which water is fed. Heat of the mercury vapor exhaust is sufficient to boil this water, and the resulting steam passes through a pipe to drive a steam turbine. The mercury, now condensed to a liquid, returns by gravity through a pipe to the mercury boiler, completing its cycle

The secret of the increased power efficiency lies in the fact that the heat generated for a single power plant is utilized to drive *two* power plants instead of one.

Reports of the remarkable performances of the invention in the Hartford plant indicate what we may expect of it eventually in the saving of fuel and consequent reduction in the cost of electric power to consumers.

Predict Huge Savings

In Hartford, with a population of 175,000, the Hartford Electric Light Company spent about $1,500,000 in 1922 for fuel to generate electricity for homes and factories. Using the mercury power system, officials of the company announce that they expect to save $750,000 a year on fuel with the present installation, or $250,000 more than the cost of installing the system.

Officials of both the General Electric and the Hartford companies say that the chief saving to the public will come indirectly through the lessening of demand for fuel and the extension of uses for electricity, rather than through any immediate reduction of electric rates.

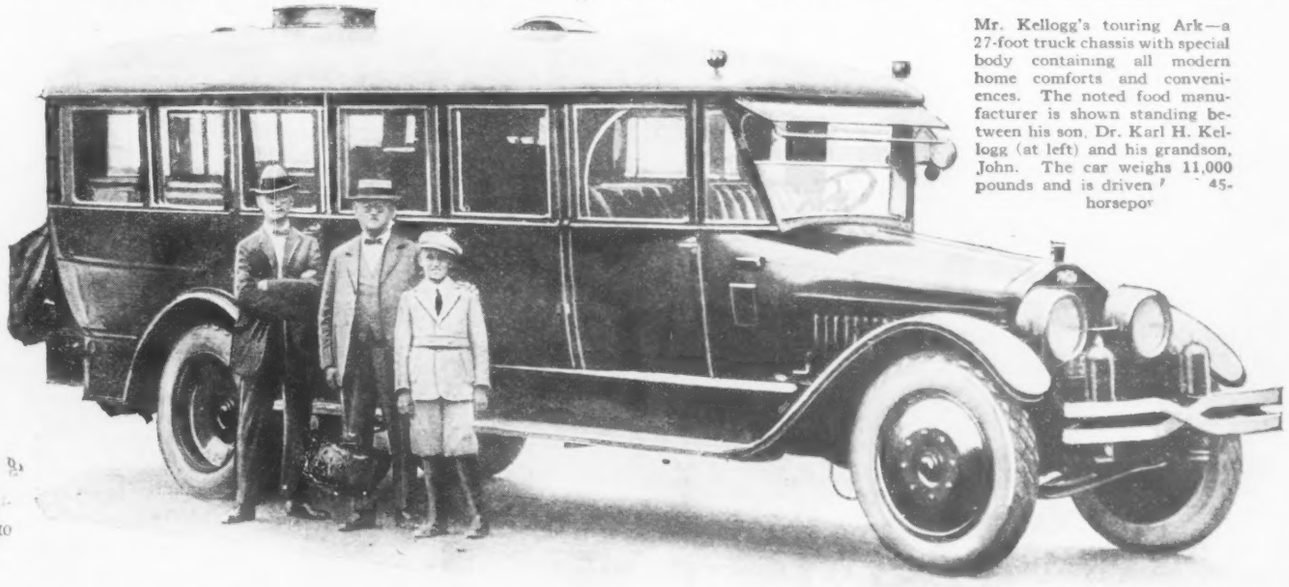
The idea of the mercury boiler is based on the fact that mercury boils at a much higher temperature than water, though not too high for ordinary fuels. Thus, much more heat can be stored in mercury vapor than in steam. As the mercury is vaporized to drive a turbine, this excess heat is passed on to an auxiliary steam plant which in turn drives a steam turbine. Thus the mercury system literally "kills two birds with one" stone. It runs two power plants instead of one.

In the Hartford plant the mercury boiler occupies the space required for a 600-horsepower water boiler, yet it develops 5300 horsepower. It uses 30,000 pounds of mercury; yet experiments since its installation promise that slight changes in design will cut this quantity in half.

Mr. Emmet's apparent success in producing a revolutionary power-producing apparatus crowns a career rich in scientific achievement. The inventor is an Edison medal winner, conductor of notable research in the uses of alternating current, the developer of the Curtis turbine, and the father of electrical marine propulsion.

"No Place like a Home on Wheels"

A Modern Noah's Account of His Travels in a Motorized Ark



Mr. Kellogg's touring Ark—a 27-foot truck chassis with special body containing all modern home comforts and conveniences. The noted food manufacturer is shown standing between his son, Dr. Karl H. Kellogg (at left) and his grandson, John. The car weighs 11,000 pounds and is driven by a 45-horsepower

By W. K. Kellogg

EVERY motorist or prospective automobile owner who has felt the lure of the open road will find enjoyment and profit in this unusual article by W. K. Kellogg, noted food manufacturer of Battle Creek, Mich.

Here he tells how he found the secrets of health and happiness in the untraveled places—how he conceived and built his motorized ark, a cozy traveling dwelling on wheels equipped with every appointment of the modern home, even a radio set.

Of course, not every man can own such an ark; yet who is there who cannot find the same happiness as Mr. Kellogg's in the pursuit of a congenial hobby, or reap the same benefits in health by meeting Nature on intimate terms in out-of-the-way places?

LIKE Noah, I have built an ark.

Not that I am anticipating another deluge. On the contrary, my ark, though capable of withstanding severe storms, is strictly a land craft. Also, it was not designed to supply a necessity. It was built for amusement—so that I might give full expression to my only hobby, which is motor touring.

My Ark is a 27-foot automobile—a truck chassis on which I have mounted a special body containing all the comforts any one might desire by day or night on an extended tour.

It is equipped with beds, tables, easy chairs, a kitchen, a bathroom, a heater, a refrigerating plant, even a radio set. It carries camping equipment, including a 15-foot folding motorboat.

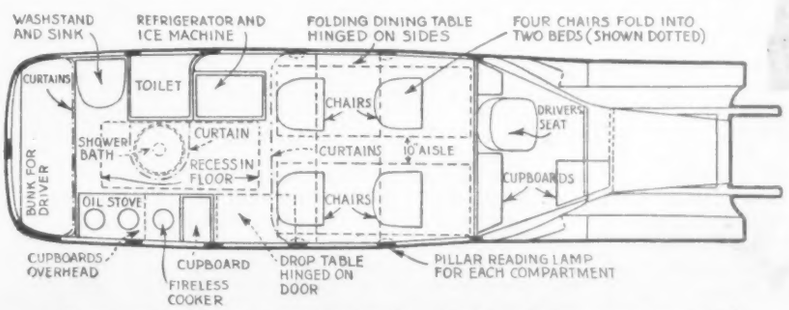
It can travel at from 30 to 35 miles an hour over comparatively rough roads without discomfort to the passengers and without interrupting enjoyment of radio broadcasting programs as they are reproduced by the loudspeaker hanging over the chauffeur's seat.

The concern that built the Ark for me calls it a "special Pullman tourist coach." But it is more than that. It is a real home on wheels, permitting me to go where I please for as long a time as I please without worrying about hotel accommodations, railroad connections, or any of the other vexations of the ordinary "trip."

In the Ark is incorporated the results of what I have learned in 15 years of motor touring, as well as suggestions I obtained by collecting all available data regarding the experiences of other tourists and automobile campers. It is unique, but it is in no sense a freakish vehicle. It is entirely practical and useful. In building it I made no attempt to attain luxury or unnecessary elaboration. What I wanted was the essentials of a well-ordered home in order that in touring I might become independent of the territory through which I might travel. Thus far it has performed wholly up to expectations. Mrs. Kellogg and I now are well along on the first lap of a tour which, within the next year or 18 months, will take us to the capital of every state in the Union. This winter we are touring the South. In the spring we shall go north, then cross the continent up and down until we have completed our itinerary. Practically our entire time will be spent in the Ark. We shall travel in it, eat our meals in it, sleep in it, except for such times as we may find ourselves near good camping and fishing grounds, when we shall get out our camping gear and approach closer to Nature than even the Ark permits us to do.

This is my idea of real motoring, of getting full use out of a car. People who motor on the beaten tracks—through city parks, over well-paved roads that skirt inhabited places—miss many of the thrills that come from pursuing this healthful, invigorating sport through the open country. Playing the vagabond in a motor car is the most fascinating pastime I know of; and, in my opinion, it is the most satisfying, helpful hobby a man could have.

I am prejudiced, of course, but with good



Diagrammatic view of the interior of the Ark, showing the ingenious arrangement of living and sleeping quarters, and equipment of home comforts, with no waste space

Interior view of the Ark, looking toward the rear, showing refrigerating machine, electric stove, utensil cabinet, and other modern household appointments

How the luxurious sitting room is transformed into berths. The seats, at left, are converted into a bed, as at the right, with curtains extending from the roof to the floor

A light lunch on the road. This view, looking forward in the Ark, shows convenient drop tables, electric lights in the ceiling, and the radio loudspeaker at the far end. For each pair of chairs there is a table

reason; for motoring restored my health to me many years ago and has kept me in good health ever since. I had been troubled with insomnia. Nothing that I did seemed to afford me any relief. Then, almost providentially, the motor car came along. In the early days of motoring I bought a small car, from which my Ark is a logical development. In the succession of cars that followed that first one I have toured many parts of the country, mostly over highways that were little traveled.

Driving through the open spaces, drinking in fresh air, feasting my eyes on the marvelous scenery, triumphing over small difficulties and adventures and performing the work necessary to keeping a car running under rough usage—these things banished my insomnia and made me an incurable devotee of motor touring.

I found out, too, what real delight there is in pitching a tent on the bank of a stream and camping there to fish and rough it. When a man learns to do his own crude camp cooking, he gets a keen relish out of his food, a relish that is absent from the most tastefully served meal he can order at a hotel. Those who have eaten fish whipped out of a brook, cooked above a hastily [illegible] fire and served up in regular camper's style, know what I mean.

Camping Trailer Led to the Ark

I became so fond of camping that a camp outfit became a most essential part of my touring equipment. To carry it better, I hitched a trailer on my car about five years ago. That worked satisfactorily for a time, but after the novelty had worn off, the trailer became a white elephant rather than a convenience. Looking around for something to substitute for it, I hit on my Ark idea.

The Ark has a wheel base of 198 inches, and carries a 45-horsepower motor. Its tires are 36 by six, each of the rear wheels being equipped with two. Complete, the car weighs 11,000 pounds.

The seats are four armchairs mounted on swivels. Their backs are adjustable, with removable head-rest extensions. The chairs may be converted quickly into twin beds—not merely berths, but real beds—with curtains from roof to floor giving the privacy of sleeping-car berths. Folding tables placed between each pair of chairs transform the interior of the car from a living-room into a dining-room.

In the rear is a refrigerator with an icemaking plant, a lavatory and toilet room provided with running water from a pressure tank, an electric fireless cooker stove, a two-burner oilstove for emergencies, a heater for cold weather, and a shower bath. Minor equipment includes a telephone to the chauffeur's seat, window screens, a combination electric toaster, boiler and egg poacher in the kitchenette, and a radio set, the aerial of which is concealed in the roof.

One piece of personal equipment that I carry in the Ark, as I have carried it on all my motor tours, is a camera. A photographic diary of an extended motor trip permits you to live through your trip and enjoy it again, whenever you wish.

Plan that Summer Tour Now

Spring and summer, ideal times for motor touring, will be with us soon. If you have a car, or if you are contemplating buying a car, start making plans right now for a real tour in it before this coming summer ends. Pick out a route that will take you away from the inhabited places. Get a camping outfit and sleep in the open. Take a camera along and let it keep a diary for you. Thousands of people in the United States are doing that every year. They are getting real value out of their cars, even receiving dividends in the form of health and happiness on what their cars cost them.

How to Buy a Home

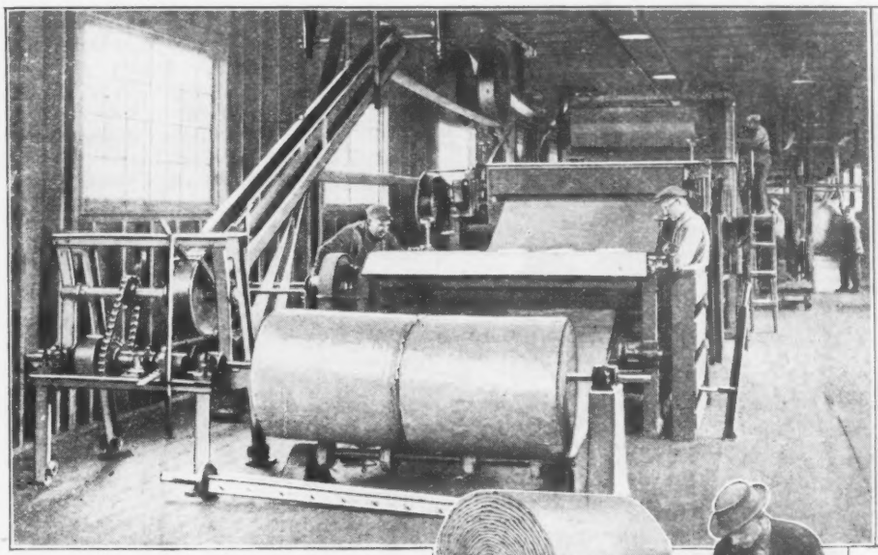
FOUR fascinating adventures in home ownership, answering in understandable language the thousand and one problems that usually confront the prospective purchaser, will appear in POPULAR SCIENCE MONTHLY, beginning next month.

In four articles of a series, to be published in consecutive issues, the science of home buying and home building will be explained in a comprehensive and entertaining way by one of America's foremost writers on popular architecture—Phil Madison Riley. Here they are:

1. How to Buy a Ready-Built Home
2. How to Finance the Purchase of a Home
3. How to Build a New Home
4. How to Equip the Home for Comfort

Whether or not you are planning your own home this year, you won't want to miss any of this extremely useful and interesting series.

Fireproof Wall Lining Made from Waste Lumber



Part of the factory at Cloquet, Minn., where fireproof "wool" is manufactured from waste

Testing the fireproofing of the new material with a blowtorch. It is said to take 4½ minutes for the flames to penetrate the half-inch thickness of the material

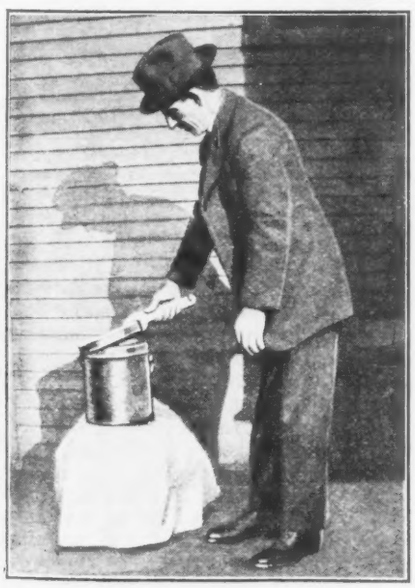
Applying the insulator to a wall. The strips, 16½ inches wide, are said to fit snugly between the studs, automatically forming flanges along the sides and ends. These flanges are held tightly against the studs and plates by lathe or nailing strips. Thus every crevice is sealed tightly

HOUSEHOLD fuel bills can be cut from a quarter to a third, it is claimed, by insulating the walls of the home with a fireproof "wool" now being made from waste lumber at Cloquet, Minn. This material is said to be nearly as effective an insulator as pure wool, which, of course, is too costly for building purposes.

The insulator is a flexible blanket made of spruce lumber waste cemented together and packed between two sheets of asphalt-lined, tough, waterproof paper. The waste is chemically fireproofed first, and then thoroughly dried by fans and several miles of steam pipes. Shredding machines macerate it thoroughly, this process creating more dead air spaces. Finally, it is cemented with a special adhesive, dried and packed between the sturdy covering sheets. These previously have been coated on one side with a film of hot asphalt that cements them to the wool mat and makes them moisture-proof.

The finished product is said to be light, flexible, and easy to apply. Because of its flexibility it accommodates itself to shrinkage or vibration of the building framework.

The effectiveness of the fireproofing was demonstrated strikingly when, in a recent test, a blowtorch required four minutes to penetrate the material. The chemicals in the fireproofing are said to have extinguished the fire soon after the torch was withdrawn.



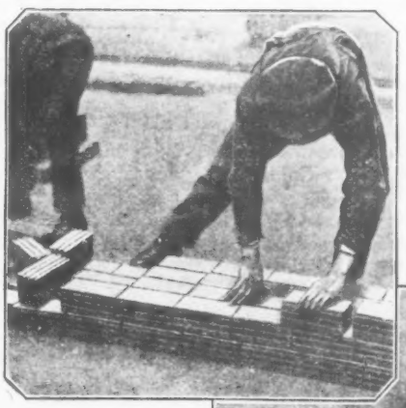
An Ice-Cream-Can Opener

THE difficulty encountered in removing ice-cream-can covers that have been frozen fast has led to the invention of this cover lifter—a bottle opener on a large scale, with a long upper jaw and a short lower one that hooks under the rim. The lid is raised with little effort.

Noiseless Street Paved with Rubber Bricks

THERE is one street in the world through which the heaviest traffic may pass without noise. It is a street called "Holborn," in London, England, which has just been paved with rubber bricks. Mr. E. F. Spurrell, borough surveyor, supervised the installation of this novel pavement, of which he is the inventor.

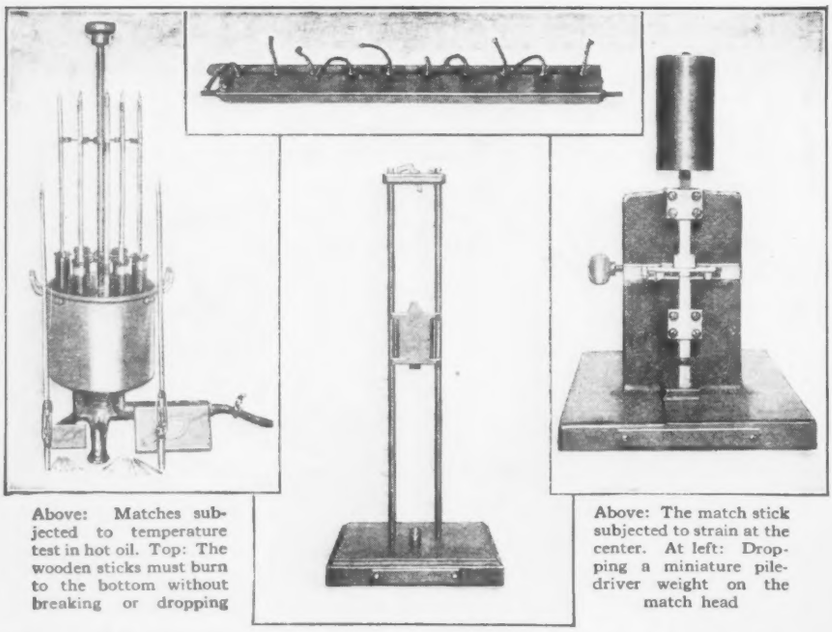
The rubber bricks are similar to the wood blocks extensively used in street paving and measure 9 by 4¼ by 3 inches. It is expected that they will last for at least 15 years and they can be manufactured for the same price as ordinary creosoted wood blocks.



Workmen paving a street in London, England, with rubber bricks. These blocks are shown piled at the left. They are grooved at the sides and are laid so that they fit into each other on a solid concrete base

Photos courtesy *Highway Magazine*

THE Editor will be glad, wherever possible, to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly. Letters of inquiry should include the month of issue and number of the page on which the device is mentioned.



Above: Matches subjected to temperature test in hot oil. Top: The wooden sticks must burn to the bottom without breaking or dropping

Above: The match stick subjected to strain at the center. At left: Dropping a miniature pile-driver weight on the match head

How Science Tests Matches for Your Safety

THE plebeian match, common, cheap, yet sometimes capricious, receives respectful treatment from the Underwriters' Laboratories. Above are pictured scientific tests by which the laboratory investigators keep your matches safe for you.

First, several of the matches on trial are placed in tubes equipped with thermometers and resting in oil. The oil then is heated until the matches ignite. If ignition occurs below a temperature considered safe, the matches stand condemned. They could not, for example, be kept near stoves.

Next, 10 matches are inserted shallowly in sockets along a metal testing bar, and lighted. They must burn to the bar without dropping burned heads or bits of charcoal. Unless they pass this test, one of their brothers some day might cause a disastrous blaze by dropping unobserved a lighted or glowing head.

A match now is laid with its head on a tiny metal pedestal, its wooden body resting in a groove of an adjacent pedestal. The match head is directly beneath a sliding weight that resembles a pile driver. This weight is such that a safe match will not ignite when struck at the end of its fall.

Finally, a match, supported at each end, is strained by a gradually applied weight. If the wood remains uncracked, the matches are not likely to break in two when struck, so that the blazing end might endanger curtains, paper, or hair.

New Weight Machine Measures Pull of Horses

BY MEANS of a weight-lifting machine, the pulling power of horses, as well as the effect of various road surfaces on it, has been determined with great accuracy by the Horse Association of America. The machine, called the "dynamometer," is the invention of Prof. E. V. Collins, of Iowa State College.

At the recent National Horse Show in New York City, Bob and Pete, a team of 10-year-old truck horses, weighing together 3500 pounds, accomplished a pull equal to lifting 2450 pounds from a well, a feat said to have astonished veteran horsemen.

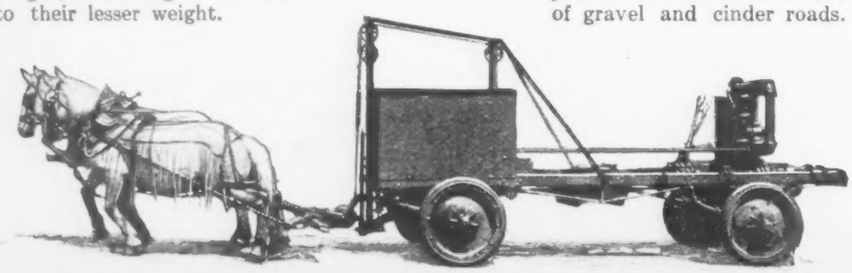
In other tests a team of mules, weighing 2600 pounds, failed to raise a 2000-pound weight, this being attributed to their lesser weight.

The tests are said to have demonstrated that horses can pull from six to eight times as much as usually is required of them, particularly on city pavements.

Old and worn brick paving was found to require a tractive pull of 290 pounds—almost two horsepower—for a wagon and contents weighing six tons, while new and smooth brick paving required only 200 pounds, about 1 1/3 horsepower.

On asphalt paving the required pull increased to 560 pounds, or 4 2/3 horsepower. Concrete paving was found the least exacting.

Dirt roads, apart from their greater ease to the horses' feet, demanded greater pulling power than did roads that were paved. The same was true of gravel and cinder roads.

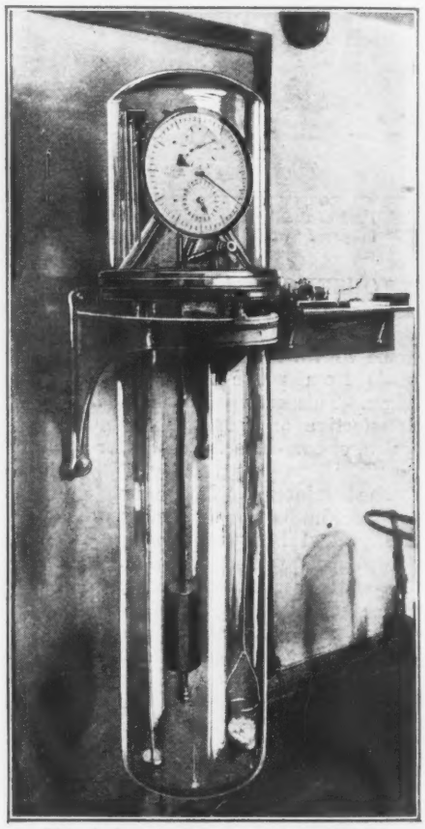


Measuring the pull of a team of truck horses hitched to the weight-lifting machine

Most Accurate Clock Ticks in Airtight Room

A CLOCK that has varied less than one second in 2½ years ticks off the hours in the Case School of Applied Science, Cleveland, Ohio. It is said to be the world's most accurate timepiece.

It is mounted in a special airtight room, surrounded on all four sides, ceiling, and floor by four-wall partitions, which provide three separate air spaces. Its foundation is a stone pyramid, which in turn rests on a concrete base 16 feet square. Beneath this concrete is the natural shale upon which the building rests. Thus approximate freedom from vibration is achieved. This room is entered through a temperature trap with four doors.



This clock at the Case School has varied only a fraction of a second in 2½ years

Accuracy is enhanced by the fact that only a suspended ribbon of spring steel gives contact between the counting mechanism and the pendulum. The latter is an alloy of nickel and steel, which is declared to be almost indetectably affected by temperature changes. Automatic winding is accomplished electrically every 32 seconds.

The air through which the pendulum swings is rarefied by a pump that automatically compensates for temperature changes. A change of one millimeter in air pressure, it is said, would vary the clock's rate more than one hundredth of a second a day.

OWING to the large number of contributions in the contest, "Why I Value My Hobby," it is impossible to announce the prize-winners this month. The announcement will appear in the April issue.

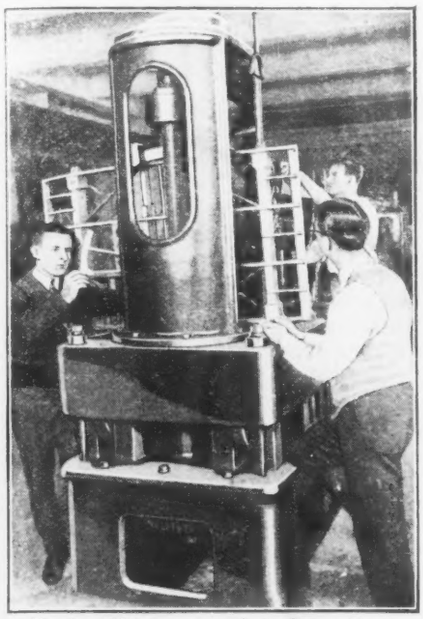
lid is raised with little effort.

on which the device is mentioned.

University Offers Course in Airplane Design

THE first college course in airplane design and construction to be offered in the United States has been launched at New York University, New York City. A surprisingly large enrolment attested the demand for such instruction.

The innovation has been indorsed by President Coolidge and high army and navy officials, who have expressed the deep hope that it may result in American leadership in aeronautical construction and performance.



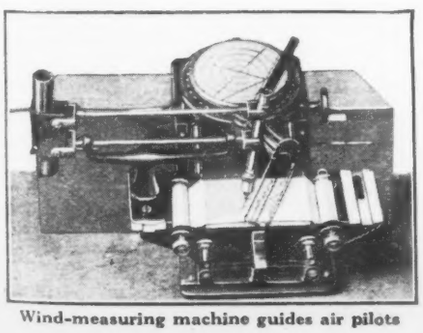
Testing lifting power of airplane wings

The photograph shows students in the laboratory of the university testing the lifting power of an airplane wing by subjecting it to high pressure. The course is under the direction of Prof. Alexander Klemin and a corps of technical experts.

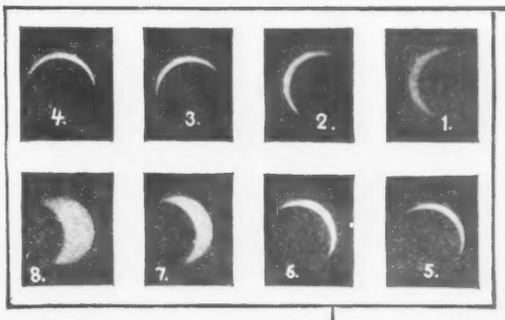
Mechanical Aerial Pilot Measures the Wind

PRECISE measurement of the drift of an airplane off its course, due to a side wind, is said to be possible with a new instrument, designed to calculate wind velocity and to indicate the true course of an aircraft.

It determines instantaneously the angle at which the aviator must fly to windward of a straight course in order to reach his destination without having to turn back from leeward. This measurement is automatic.



Wind-measuring machine guides air pilots

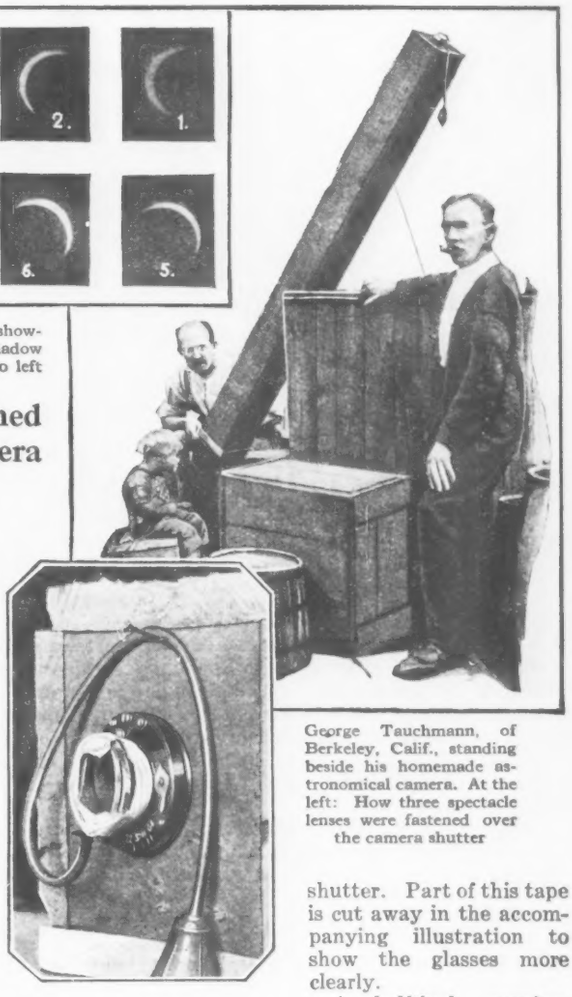


Eight stages of solar eclipse, showing passage of the moon's shadow across the sun from right to left

Eclipse Photographed by Homemade Camera

FOUR seven-foot boards, three lenses from old spectacles, some black building paper, a camera shutter from which the lens had been removed were combined by George Tauchmann, of Berkeley, Calif., into a homemade astronomical camera with which he took excellent photographs of the recent solar eclipse. These photographs are reproduced above.

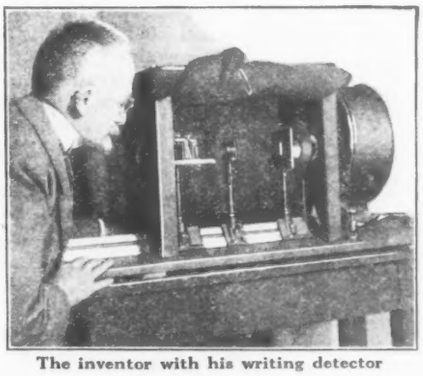
The boards formed a six by six inch box, which the black paper lined to keep the light off the inside walls. The three spectacle lenses then were laid on each other crosswise and were bound with white friction tape to keep them together. This tape also was used in fastening the improvised lens to the front opening of the shutter. Part of this tape is cut away in the accompanying illustration to show the glasses more clearly.



George Tauchmann, of Berkeley, Calif., standing beside his homemade astronomical camera. At the left: How three spectacle lenses were fastened over the camera shutter

A half-inch opening, about 1/170 the length of the focus, was used and an exposure of 1/25 of a second given each picture.

Invisible Writing Made Visible by Detector



The inventor with his writing detector

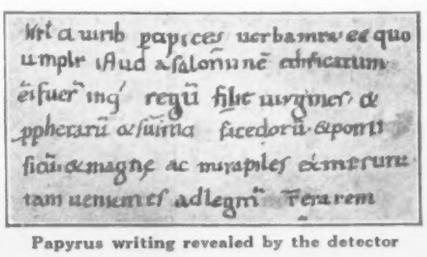
MANY a precious literary relic may be recovered, after centuries of oblivion, by a new German method designed to make visible papyrus and parchment writings that apparently have been obliterated. This method also may be applied to military intelligence and scientific crime detection by revealing invisible writing.

Thousands of ancient manuscripts were erased during succeeding centuries so that the papyrus or parchment might be used again. Papyrus writing was erased by passing a wet sponge over it, and parchment writing by rubbing it with pumice-stone.

It was to recover this lost literature that Prof. H. Kögel, of Karlsruhe, Germany, invented the new detector.

Parchment and papyrus belong to a class of substances that give off a faint yellow light when exposed to ultra-violet rays. When such rays are directed at one of the ancient manuscripts, all but the parts once wetted with writing fluid are said to give off this yellow light, making the invisible writing visible.

Quartz instead of glass is used in the detector because glass absorbs ultra-violet rays. A quartz lamp produces the rays, while two quartz prisms spread them in a long spectrum on a screen about 10 feet away, after sending them through a narrow slit.



Papyrus writing revealed by the detector

This Indoor Football Game Requires Kicking Skill

A NEW game of indoor "soccer" football has recently been invented by Percy Mason, of Hendon, near London, England, to give devotees of the kicking game a popular household version of the sport. It is said to afford much of the excitement of offensive play and skilful passing across the field that is found in the outdoor game.

The game is played under a net, which is mounted upon a rigid support in such a way as to allow each player sufficient room between the net and the floor for him to insert his foot. Each player therefore has a limited field of action, and a considerable amount of skill and practice is required before he can learn to use this small space to best advantage.

World's Smallest Fishes

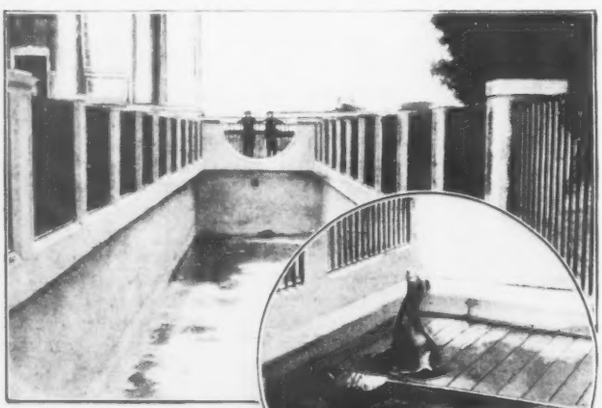
PROBABLY the smallest species of fish in the world—the smarapan—is found near Luzon, Philippine Islands. It weighs half a grain, and is half an inch long.

World's Greatest Aquarium Has 57 Tanks

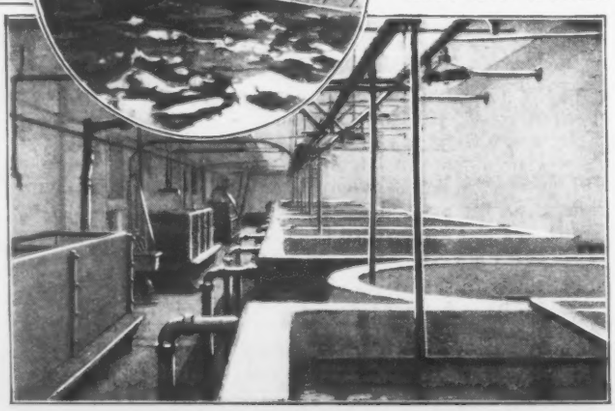
WHAT is said to be the world's most perfectly equipped aquarium was completed recently in Golden Gate Park, San Francisco, at a cost of $300,000.

Fifty-seven ponds and tanks are provided for an unusual variety and number of fishes. Thirty pools and aquaria will shelter other marine creatures. There are three outdoor pools for seals and a special pond for alligators, snakes, and turtles. A complete heating plant and a complete refrigerating plant supplies warmed and cooled water for tropical and arctic fish respectively.

An impressive biological library and a thoroughly equipped laboratory will afford students and research workers unusual opportunities. A large collection of stuffed fish and other marine animals will supplement these facilities.



One of the large tanks in the new San Francisco aquarium is shown above. The picture in the circle shows one of three outdoor pools for the use of the seals



At the right: A view of some of the 57 tanks for fishes, showing the pipes that convey water from heating and refrigerating plants that keep it at correct temperature

Convenient Notary Seal Resembles a Watch

A NOTARY'S seal that resembles a watch now is available for notaries who travel or who for other reasons often are called upon to seal documents away from their offices. It can be carried either in the vest pocket, as a watch is carried, or in a lady's purse or handbag.

Pressure or a slight blow on the case makes the impression

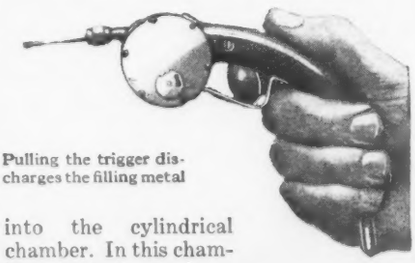
To seal a document with the device, one opens the case, inserts the paper and then closes the seal. Pressure with the fist, or a slight blow, will effect the desired impression.

The notary's watch seal, with case open (above), showing the embossing punch and die, and with case closed (at the right)

Dentist's Pistol Designed for Filling Teeth

YOUR dentist soon may be filling your teeth with this compressed-air pistol, a recent Australian invention that discharges gold or amalgam into the cavity.

Pulling a trigger opens and closes a spring-controlled valve in a channel extending through the handle of the device into the cylindrical chamber. In this chamber a wind wheel, or rotary fan, is whirled by the force of the air pressure conveyed in the tube to which the pistol is attached. When the trigger is pressed, the rotating fan discharges the gold through the small barrel.



Pulling the trigger discharges the filling metal

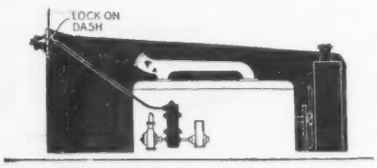
The instrument is said to replace the slower method of picking up the filling material particle by particle.

Louis Reichart at work on the auto alarm clock that he has invented

Novel Auto Lock Sounds a Warning Rattle

A STARTLINGLY unpleasant surprise awaits the thief who undertakes to steal a car equipped with a new protecting device that causes a betraying chatter, loud enough to be heard several blocks, as soon as the car is started. The device is the invention of Louis Reichart, a construction engineer of Philadelphia, Pa. It weighs but a few ounces.

Unlike other alarm devices that depend on a lock or on current from the battery,



Installation of lock and dash control

this invention can be silenced neither by a thief's key nor by disconnecting wires.

A toothed wheel is attached to any exposed shaft, upright or vertical, on the engine. A spring tongue engaging the wheel is controlled from the dash by a keyless lock capable of an infinite number of combinations. When the owner leaves the machine, he sets the lock, causing the tongue to engage the teeth of the wheel. Any attempt now to start the motor, by causing the shaft to rotate, will set up the chattering that betrays the thief.

A split aluminum housing guards the entire assembly, which, of course, is mounted on the shaft. The device is said to function on right- and left-hand motors.

Declares Ants Are Topers

ANTS consume more alcohol in proportion to their body weight than does the most accomplished "old soak," asserts Prof. Paul Lindner, chief of the Fermenting Industry Institute in Berlin, Germany. The industrious insects manufacture their own home-brew in their digestive canal by the action of yeasts on the milky juices that they extract from aphids, or plant lice, which they keep for that purpose.

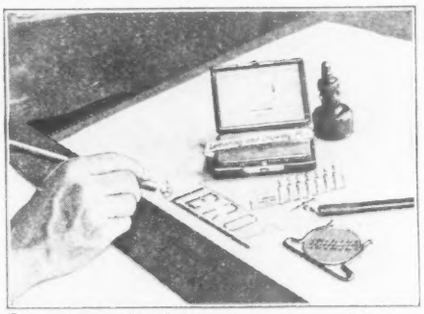
Other insects have similar homemade home-brew outfits that they use to capacity, Doctor Lindner stated. Wasps are accomplished bootleggers.

Self-Inking Drawing Pen Makes Uniform Lines

FOR architects, artists, and others who do drawing or lettering involving uniform lines of various thicknesses, a new tubular fountain pen has been invented.

Eight points of different thicknesses, each connected with a tubular ink reservoir, are used in the same penholder, fitting in the holder as do ordinary points. A plunger, the tip of which projects slightly beyond the tip of the point, runs through the pen into the ink tube. The hollow interior, which is filled with ink, is said to have greater capacity than most pens made for this purpose.

Using the pen pushes in the projecting tip of the plunger, releasing ink in a constant flow and insuring a uniform line independently of the pressure applied.



Lettering outfit, showing interchangeable pens

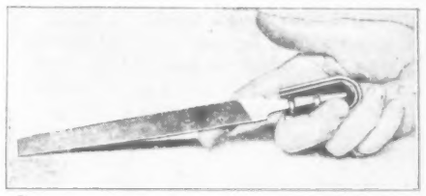
A setscrew on the point permits adjustment of the drawing angle to individual preference. The pen also is adapted to follow the edge of a T-square and to be used as a ruling pen.

Sandpaper Gives Warning of Poison in Bottle

POISON bottles and bottles of harmless medicine feel the same to fingers in the dark. As a precaution against any possible mistakes, paste a strip of sandpaper on the poison bottles.

Metal Grip for the File

THIS metal grip, said to fit the handle of any file, protects the palm of the hand from irritating contact, besides providing a surer grip.

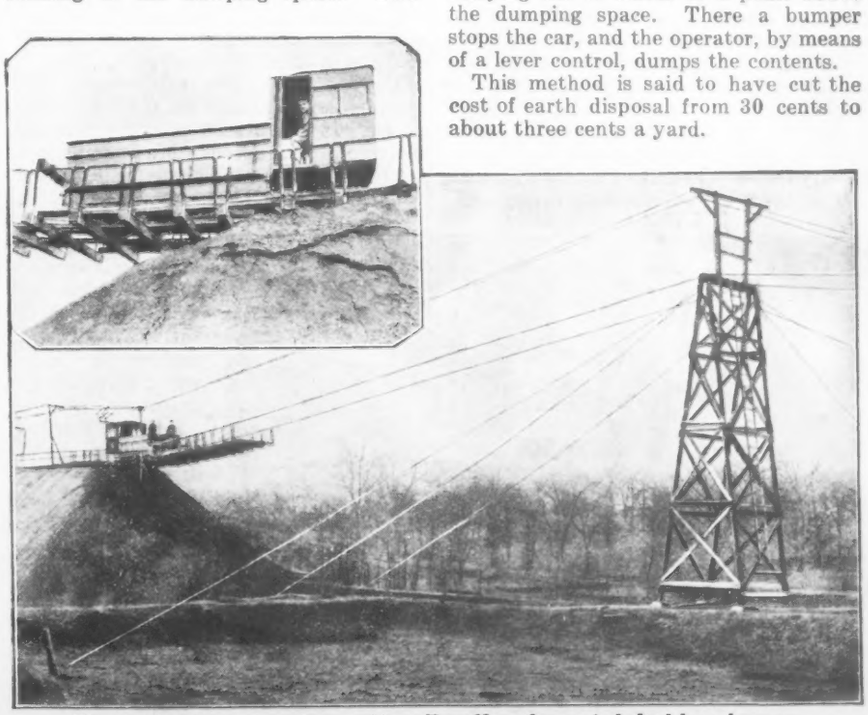


Cut-away view, showing handle attachment

Dump Carts Supplanted by Aerial Railway

BECAUSE the disposal of valueless earth by cartage proved too expensive, an Iowa clay products company has constructed an unusual aerial railway running to the dumping space. Two parallel cables were strung to a supporting tower. A suspended track, swung 30 inches below the cables over the first 30 feet of the aerial course, permits an earth-carrying car to travel to a point above the dumping space. There a bumper stops the car, and the operator, by means of a lever control, dumps the contents.

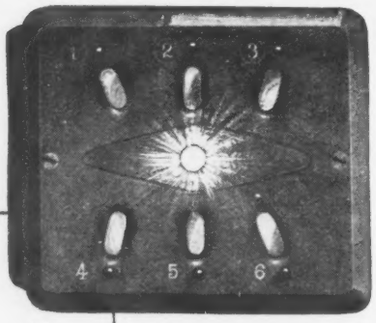
This method is said to have cut the cost of earth disposal from 30 cents to about three cents a yard.



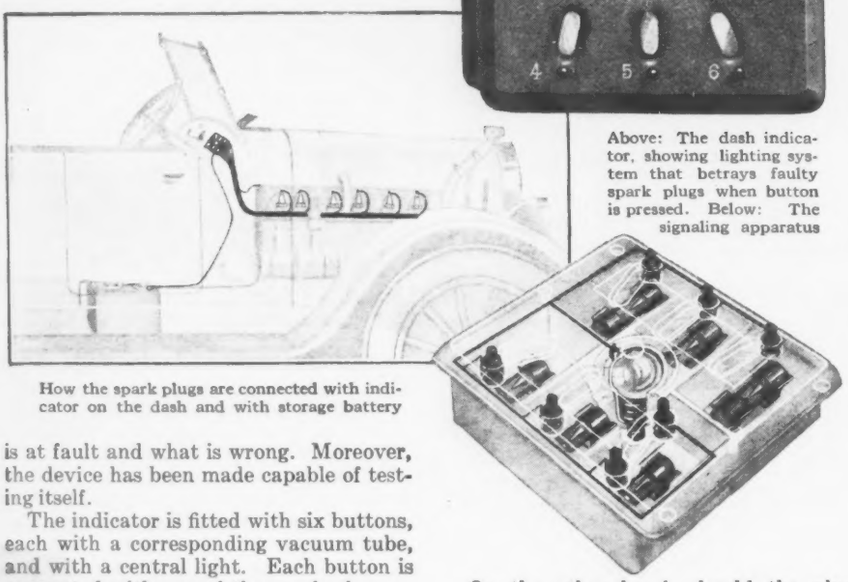
The aerial railway slung from cables. Top: How the car is halted by a bumper

Dash Indicator Locates Faulty Spark Plugs

DIAGNOSING spark-plug trouble with six buttons and a light, this ingenious new automobile dashboard convenience is said to reveal instantly which cylinder



Above: The dash indicator, showing lighting system that betrays faulty spark plugs when button is pressed. Below: The signaling apparatus



How the spark plugs are connected with indicator on the dash and with storage battery

is at fault and what is wrong. Moreover, the device has been made capable of testing itself.

The indicator is fitted with six buttons, each with a corresponding vacuum tube, and with a central light. Each button is connected with one of the spark plugs.

Should a plug be operating defectively because the points are too widely separated, or because of a carbon or oil deposit increasing the resistance, the guilty plug is identified by pressing, successively, the various indicator buttons. A light will glow in the vacuum tube corresponding to it. This is because the wiring system permits the current to pass through the vacuum tube instead of the plug if the resistance is too great.

On the other hand, should the plug points become faultily adjusted, so that the current has a lower resistance and no spark results, pressing the indicator buttons again will inform the driver. The central lamp will light when the button corresponding to the miscreant plug is pressed.

Even the device itself can be tested. A test button is provided, which, when touched, will cause the central light to glow if the instrument is functioning properly.

Tiny Electric Fan Screws into Light Socket

FOR muggy summer days, a little portable electric fan, only slightly larger than a man's hand, has been invented. It screws into any light socket and the high pitch of its blades is said to enable the tiny high-speed motor to throw a strong current of air.

The tiny fan, showing pitch of blades

A universal joint between the fan and the motor permits the blades to be turned in any direction.

The marked pitch of the blades is said to account for the fact that a far stronger air current, in proportion to size, is possible with this midget fan than with one of the usual size. A similar pitch on an ordinary fan would tend to topple it over.

Merchant Uses "Stand-Up" Desk to Keep Well

George Lytton working at his desk

TO GEORGE LYTTON, wealthy Chicago merchant and former national amateur heavyweight boxing champion, lounging on his backbone while he worked seemed to be devitalizing, not to say dangerous. Believing that mental vitality is directly proportional to physical vitality, he devised this "stand-up" desk. Standing at the desk he does whatever office work the day requires of him.

He declares that as a result of his new system he feels more fit in every way at the end of the day's labor.

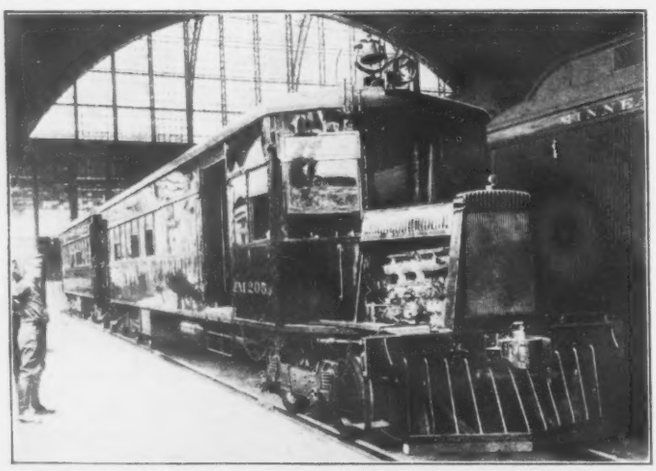
Gas Replaces Steam in Railroad Locomotive

ENGINEERS of the newest locomotives on the Chicago & Great Western lines no longer open the throttle. Instead, they throw her into high and step on the gas, for the new locomotives are gasoline-driven—actually big automobile engines.

Except that there is no necessity for a steering wheel, driving these engines is exactly the same as driving an automobile.

The motor-driven locomotives are said to have proved themselves capable of remarkable performances, and the experiment of the Chicago & Great Western is being observed with interest by the executives of other railways.

The new locomotive is driven by a six-cylinder engine said to develop 245 horsepower. It is provided with five forward and two reverse speeds. Maximum speed is 60 miles an hour in forward motion, and 15 miles an hour backward. The weight of the entire car is 39,000 pounds.



Six-cylinder gasoline locomotive engine that develops 245 horsepower

Power is applied to one pair of wheels on each of the two trucks, making a four-wheel drive mechanism.

At the rear of the engine and driver's cab is a compartment for express and baggage, also a smoking compartment with capacity for seating 30 passengers. The standard railway air brakes and couplers are used.

Convenient Tray Designed for Berry Picking

A NEW berry tray, designed to permit the use of both hands in picking the vines or bushes, has been invented by George H. Owen, of Addison, N. Y.

Both hands are left free for picking

The device has an arched side resting against the picker's body and an inner section, removable by a handle, into which two berry boxes fit.

The entire device is supported by a cord about the neck and shoulders of the berry-picker. The handled inner section may be lifted out when filled and replaced with one containing two empty boxes. The invention is said to be comfortable to carry.

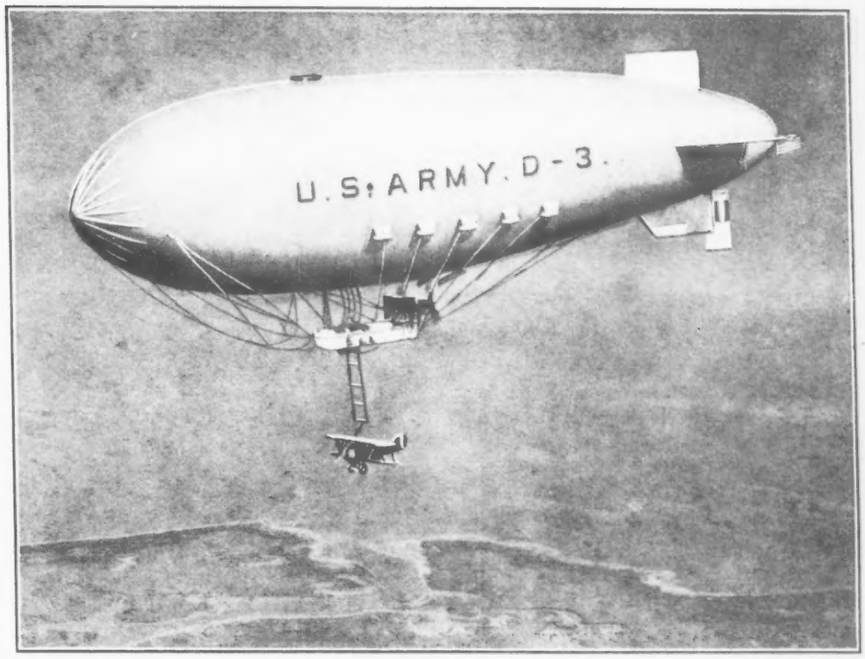
Two-Piece Tire Rim Said to Eliminate Bolts

A TWO-PIECE tire rim, said to eliminate bolts, screws, hinges, and rivets, is one of the latest contributions to the convenience of motorists.

The main rim has a recess extending halfway around the circumference, into which a tire-locking piece fits. The locking rim is slipped between the outer face of the main rim and the bead of the tire. Both beads of the tire rest on it.

Recesses are set in the outer edge of the main rim, and corresponding lugs are on the locking section. These lugs seat themselves in the pockets when the locking section is pushed into place, holding the tire securely.

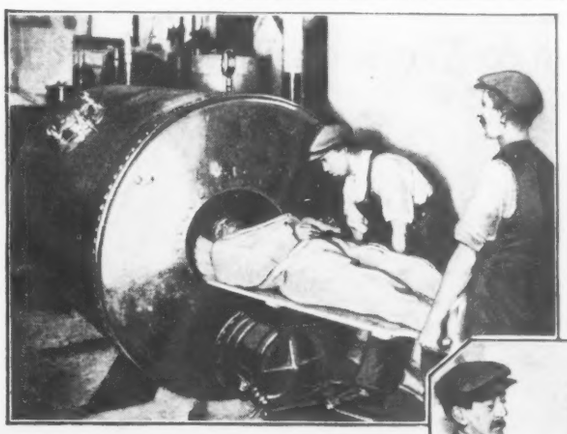
Fastening the tire with locking rim



Airplane "Hooks a Ride" on Army Dirigible

WHEN an airplane, flying 60 miles an hour, caught with a hook the lowest rung of a wire ladder suspended from the army dirigible D-3 at Langley Field, Va., recently, the dream of a dirigible carrying fighting planes became reality.

Such a mother ship could carry planes as a defense, or for an aerial attack. The use of suspended rings on the dirigibles, instead of ladders, has been proposed. The dirigible would carry supplies for the planes and furnish quarters for their men.



At the left: Demonstrating the use of a compression chamber, into which a diver who has come up too quickly from a great depth is placed to prevent the dread caisson disease

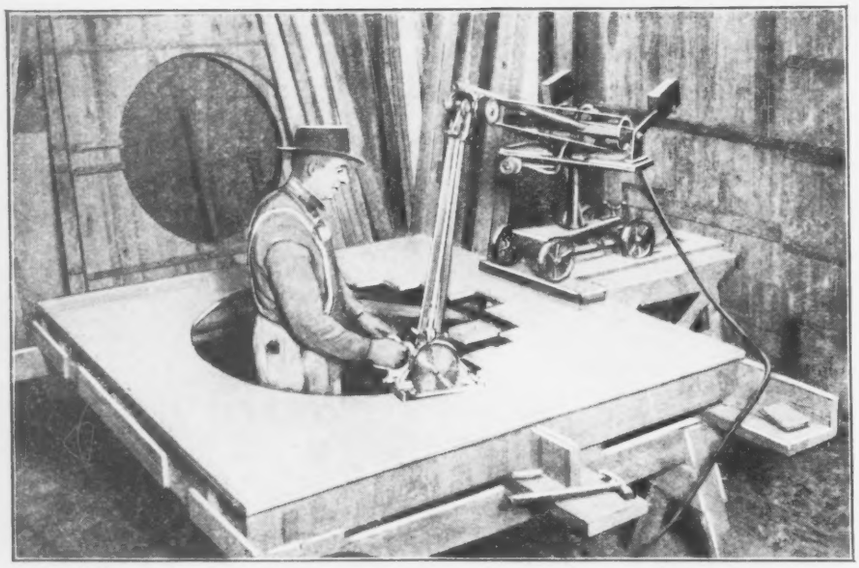
Below: A student diver donning a diving helmet for a plunge into the training tank at London, Eng.

Deep-Sea Divers Go to School in a Tank

HUNDREDS of divers employed since the war in deep-sea salvaging operations have been trained scientifically in an enormous tank built by a firm of salvagers in London to duplicate actual conditions encountered under water. In this tank they are given a complete course that is said to fit them for any diving feat they may be called upon to perform.

The equipment of the training school includes a compression chamber. Sometimes divers coming up too quickly from great depths are attacked by a type of paralysis called "caisson disease," or the "bends." This often proves fatal unless instantly treated.

The afflicted man is put into a compression chamber under a pressure equal to that of the lowest depth to which he has been just before the attack. The pressure then is decreased gradually.



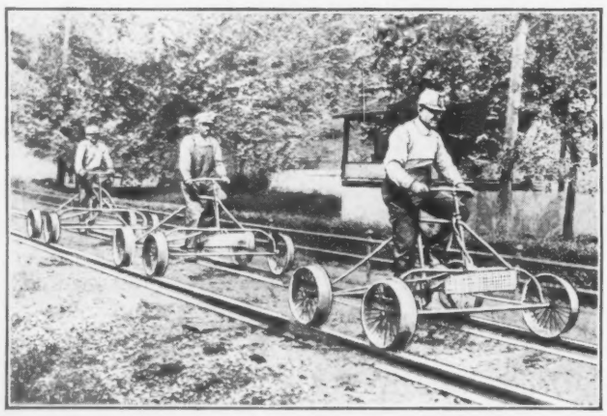
Portable Electric Saw Cuts Inside Circles

A VERSATILE and portable electric woodworking saw, embodying features hitherto said to have been found only in stationary mill saws, now is offered builders and manufacturers. It is claimed to be particularly useful in making forms, or in mortising, drilling, and planing. It will cut, measure, and square or bevel form ends.

The machine is mounted on a four-wheel carriage with roller bearings, the swivel post being carried on ball bearings. The sawing head is adjustable to cut any angle up to 55 degrees, a feature adapting it particularly to the cutting of jack rafters, as well as joists, studding, bridging, siding, and flooring. A radius rod, adjustable to different sized circles, permits the cutting of circular holes. The illustration above shows such an inside circle being cut for a column head form.

Coal-Miners Ride to Work on Railway Cycles

FOOT cars—one-man cycles with flanged wheels for riding on a railroad track — carry the employees of a West Virginia coal mine to work. By long odds the most direct route between the town where the miners live and the mine is this railroad line. The perfection of these unique carriers is said to have saved the workmen nearly an hour a day. They are pedaled, the sprocket driving the rear wheels.



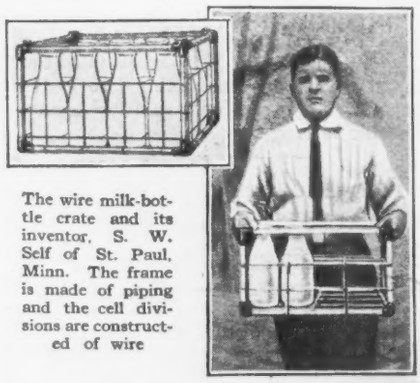
West Virginia miners riding to work on four-wheeled cycles

Sanitary Crate for Milk Bottles Made of Wire

A NEW milk-bottle crate for which are claimed the advantages of lighter weight, greater capacity, better sanitation, and longer life, has been invented by S. W. Self, a dairy worker of St. Paul, Minn.

The crate now generally used is of wood, has solid sides and weighs from 13 to 18 pounds. The new crate, with a frame of piping and compartment divisions of galvanized wire, is said to weigh only eight pounds and to allow instant inspection of its contents. The pipe frame provides a handle all around the top, instead of the small slots or depressions that serve as hand grips at the sides of the usual wooden crate.

Since neither the galvanized wire nor the piping can become watersoaked, rusted, or easily worn out, the inventor believes the new crate will save many thousands of dollars for the nation's dairies.



The wire milk-bottle crate and its inventor, S. W. Self of St. Paul, Minn. The frame is made of piping and the cell divisions are constructed of wire

How to Keep Doors from Sticking in Dampness

FOR the householder who would avoid the nuisance of doors that stick in moist weather, the United States Forest Products Laboratory at Madison, Wis., points out the importance of painting or varnishing the tops and bottoms of doors —places often neglected because "they don't show." These hidden edges, if not painted, are vulnerable points where the wood absorbs or loses moisture rapidly, especially at the ends of the outside uprights where the wood grain is exposed.

HOW MUCH DO YOU KNOW ABOUT SCIENCE?

ONE sure way to gain confidence in yourself is to understand the forces that move the world and the every-day things about you. Constantly situations arise in which ignorance of simple, yet vital scientific facts may place you at a disadvantage—even humiliate you. Knowledge of these facts, on the other hand, enables you to think, speak, and act with authority and confidence.

Our monthly science questions, culled from thousands asked by our readers, offer you the roots of an invaluable habit, that of adding steadily to your store of knowledge.

Do your best with these questions, then turn to page 157 for the correct answers.

1. *Will the brain work better in a warm room than in a cold one?*
2. *Why do flowers smell sweeter after rain?*
3. *Is there such a thing as a "criminal face," a "criminal mouth"?*
4. *How are storms predicted by meteorologists?*
5. *Why is it that certain diseases afflict a person only once?*
6. *Why is the sky blue?*
7. *Are there any lost arts?*
8. *Why does an electric current cause death?*
9. *What is the will-o'-the-wisp and how is it formed?*
10. *How can you make fresh water from salt water?*
11. *What is the largest snake in the world?*
12. *What makes the colors of precious stones?*

Top of Gearshift Lever Serves as Pistol

A DETACHABLE pistol top for the automobile gearshift lever is a new invention for protection against highwaymen. By drawing back a slide with the thumb, a section of the lever is loosened. Withdrawal of this section from its position on the end of the lever automatically cocks the pistol. Pressure on a trigger permits the operator to fire two shots in less than a second, it is claimed, without attracting attention by his movement.

Since the lever is within easy reach of the driver, he has an immediate means of defense in an emergency.

Releasing the pistol grip of the lever

Collapsible Wheelbarrow for Women Farmers

IN GERMANY where, since the war, women have done much of the farm work, a light, collapsible wheelbarrow has been invented. It can be carried about easily.

The wheelbarrow in use and collapsed

How Northern Railroads Battle Snowdrifts

SNOWSTORMS are serious matters on railroads of Alaska and the Pacific Northwest. Unless prompt and vigorous measures are taken, a line may become so completely buried that only the warm winds of spring can release it. Henceforth the Copper River & Northwestern Railway will be armed with a remarkably effective new winged type of snow plow, the recent invention of Charles Dustin, one of the road's master mechanics.

A locomotive with a stout nose-type plow pulls a car equipped with a steel arm 18 feet long and tapering from four feet at the car end to 2½ feet at the tip. This may be set at any angle horizontally or vertically by levers controlled by the operator. Two compound engines, supplied with steam from the locomotive, furnish the power.

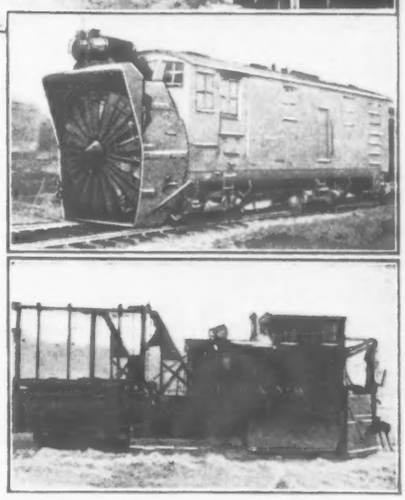
The plow on the locomotive piles the snow on both sides of the track. The steel wing then cuts down the tops of these banks, the snow gliding along the smooth, curved arm and dropping between the rails. A rotary plow follows, scattering this snow far from the roadbed. Thus high, collapsing piles are avoided.

Snow plows used on northern lines in the United States are of two general types. One, used for lesser accumulations and on comparatively straight stretches, has wings that curve out concavely, flinging the snow to both sides. The other is rotary, with blades that hurl the snow at right angles in a circular cloud. These rotary plows are more redoubtable fighters and can operate on the curves and steep grades of mountain stretches, plunging through high drifts and scattering them to the side of the tracks. The other type requires too much head-on power to do this.

Miners Guided by Smoke

MEXICANS working in a lead mine in Chihuahua, Mexico, have found a new use for cigarettes. The mine consists of a series of caves, along the sides and bottoms of which lead and silver ores in paying quantities are found.

The miners have noticed that smoke from their cigarettes is sucked through cracks in the rocks at certain points. By drilling in the wake of the smoke, they find another cave. This method of tracing ore was followed through many caves.



Top: Rotary plow in action. Center: View of blades. Bottom: New wing type plow

Ingenious Foot Plow Is Hauled by Man Power

LEG-POWER plowing is accomplished by the ingenious but muscle-taxing apparatus invented in Germany and pictured below.

Pressure on a foot lever lifts the nose of the device, while a toggle joint causes the nose to be dropped a short distance ahead of its former location. The operator then pushes forward on a bar that pulls the plow a distance equal to the forward movement of the nose.

Hand and foot levers drive the plow

Pathfinders and Their Work

New Discoveries that Add to Our Useful Knowledge

The amazing structure of the world's scientific knowledge is built of an infinite number of units—never-ending contributions from the busy minds of inquiring men and women. On this and the following page you will read of discoverers who are increasing the sum of science for our profit

The Language of Animals

ARE dumb animals really dumb? Have they not, on the contrary, some way of communicating with one another that is beyond the power of man's senses to discern? Scientists long have puzzled over this question, and the theory has been advanced that animals—birds and insects too—communicate by uttering sounds with such rapid vibrations that the ear of man cannot detect them.

A way of putting this theory to the test was developed recently, it is announced by the Westinghouse Electric and Manufacturing Company, in the invention by Dr. Phillips Thomas of an electric ultra-audible microphone, said to pick up sound vibrations that are much too rapid for the ears to hear. Besides promising to solve the secret of animal "speech," this instrument is said to have immediate practical value in permitting perfect voice transmission by radio or the telephone. Sounds heard through a radio or telephone receiver differ now from the sounds that enter the transmitter because the instruments are incapable of recording the more rapid sound waves.

* *

Stimulating Plants

POPULAR SCIENCE MONTHLY told last month how science has put plants on the night shift, making them grow 24 hours a day by installing powerful electric lights in greenhouses. Now science is stimulating plants by drugs. Professor David Lumsden, of the Federal Horticultural Board, has discovered that the growth of various plants can be stimulated by ether, which may be inhaled by the plant or injected by a hypodermic needle.

While ether puts man to sleep, it is said to exert an entirely opposite effect on plants, even reviving them when apparently they are dead. Thus frozen rose plants are said to have grown green shoots in a few hours after a single "shot" of ether, and to have thrived remarkably thereafter, resisting plant diseases.

* *

Electric Lamp Lighted by Radio

THE wireless telephone has girdled the earth. Will there be a similar development in the wireless transmission of electric power? It is the next step in the radio world of 1924, for a beginning has been made that is quite as startling as the wireless signaling experiments of 30 years ago. Dr. Willis Rodney Whitney, of the General Electric Company, a few weeks ago lighted a 110-candlepower incandescent lamp by power transmitted by radio. To scientists who witnessed the demonstration it was an event comparable with the beginnings of wireless telegraphy.

DR. NIELS BOHR, of the University of Copenhagen, winner of the Nobel prize for physics in 1922, is gaining increasing world recognition for his important discoveries of the nature and structure of atoms. At the recent meeting of the American Association for the Advancement of Science, his theory concerning the worlds and solar systems that lie beyond the range of powerful microscopes, was declared by scientists to be one of the most useful scientific tools ever placed in their hands for work of research and discovery.

MME. CURIE, co-discoverer of radium, lives not only to enjoy the highest honors bestowed on her by the President of France, but to see her great work carried on for relief of cancer sufferers. Simultaneously with the recent Paris celebration of the twenty-fifth anniversary of the discovery of radium, was held a ceremony inaugurating the Curie Foundation, an institution recognized as a public utility for consultation and treatment of all cancer patients, rich and poor alike, who turn to radium for aid.

* *

What Is the Earth Made Of?

MANY theories have been offered regarding the composition of the earth. The latest, as presented by Dr. E. D. Williamson and Dr. L. H. Adams, scientists of the Carnegie Institution of Washington, is as follows:

A small core of gold, platinum, and other metals heavier than iron. Around this, a 4200-mile sphere of iron or an alloy of iron and nickel. Next, a mixed layer of iron and rock, extending to within about 900 miles of the surface. Then a layer of rock. Covering this a surface crust, about 35 miles thick, consisting mostly of granite. These statements are based on a study of earthquake waves.

Psychology and Education

BY ITS application to industry in late years, psychology has demonstrated its usefulness, recently declared Dr. Herman P. Shearman, professor of economics at Miami University. And psychology applied to education will cause a revolution in education within the next 50 years, he added. In other words, according to Doctor Shearman, "after having devoted itself during the last century to the arts and to industry, science is now turning its attention to the primary forces of all, the forces of the mind."

* *

Conquers Disease

SINCE the war the famous British pathologist, Sir Almroth Wright, has been seeking a cure for septicemia, a dangerous blood disease. At last he conceived the idea of performing a new sort of blood transfusion by extracting the blood of a healthy person, inoculating it with an anti-septicemia vaccine and injecting it in the veins of a sufferer.

Recently it was announced that this method had proved remarkably successful. Thus another disease is yielding to transfusion—a method now used in the control of almost 30 maladies.

* *

Bird Sex Changed

TWO amazing instances of a complete change in sex in full-grown birds were reported by scientists a few weeks ago. Dr. Oscar Riddle, of the Cold Spring Harbor, N. Y., experiment station of the Carnegie Institution, told of a female dove that had become a male dove after groups of cells had been destroyed by a tubercular infection, then regenerated by nature.

A somewhat similar case is that of a Buff Orpington hen in the animal breeding research department of Edinburgh University, Scotland, which, after the age of three years, ceased laying eggs and took on the appearance and habits of a male bird of the species. These cases are regarded by scientists as being of enormous biological importance. They indicate, it is said, that the modification and control of bodily and mental characteristics in animals await only definitely directed efforts of scientific investigation, since no characteristic appears definitely fixed.

The wheelbarrow in use and collapsed

ore was followed through many caves.

Hand and foot levers drive the plow

in the Progress of Science

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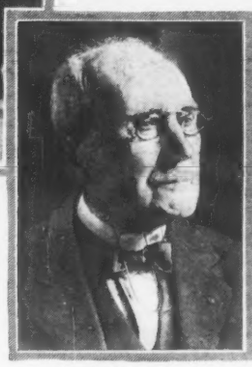
DR. J. HARRIS ROGERS, discoverer of underground and undersea wireless, is shown above surrounded by radio experts, listening in for messages from London in the laboratory of his home at Hyattsville, Md.

From left to right, in front, are: G. E. Oliver and W. L. Lesch, radio experts of the Radio Corporation of America; Dr. T. E. Latimer, personal physician to Doctor Rogers; Dr. J. Harris Rogers; W. B. Flaherty, Western Union radio engineer of Washington; A. C. Doyle, Radio Corporation of America; D. H. Beatty, safety expert

DR. H. C. GORE, of the Bureau of Chemistry, United States Department of Agriculture, with the experimental apparatus by which he has discovered a method of converting corn into sugar, imitating the processes of the human stomach. He claims to get 33 pounds of sugar from a bushel of corn, converting all the starch contained in the corn into an equal number of pounds of sugar



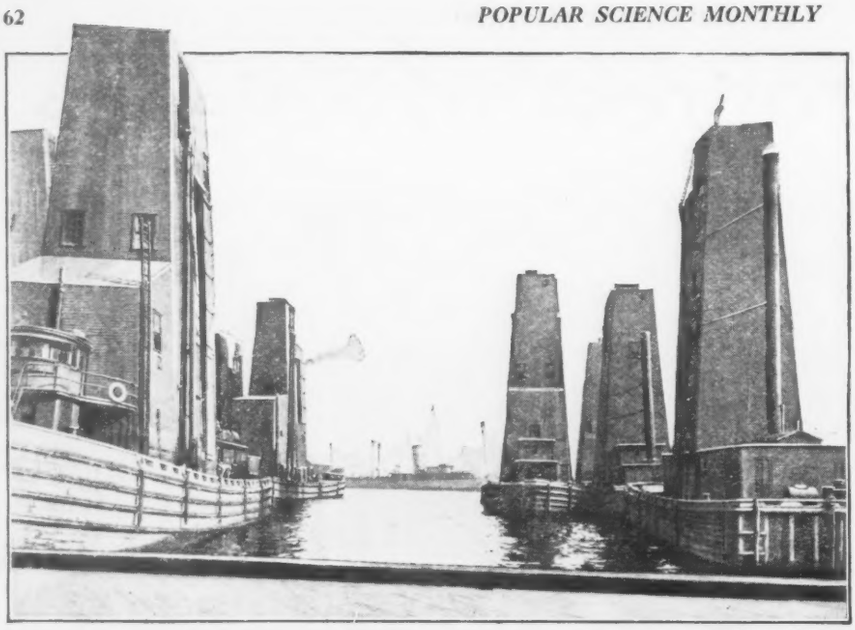
Prof. E. Branly
Paris, France

Dr. D. W. Morehouse
Drake University

DR. CLARENCE N. FENNER, volcano expert of the Geophysical Laboratory of the Carnegie Institution of Washington, D. C. After a daring descent into the steaming crater of Mount Katmai on the Alaskan peninsula, he has returned to Washington with valuable new scientific data on volcanic phenomena. He is shown above examining specimens of rock crystals found in the crater

PROF. EDOUARD BRANLY, noted French scientist, who, by his invention of the coherer, made possible the experiments of Marconi and the realization of telegraphy without a connecting cable, recently received recognition from the French government by being made a Chevalier of the Legion of Honor. Professor Branly is 80 years old, yet he still works in his laboratory in Paris where he made his important discoveries. Above is a recent portrait

DR. DANIEL W. MOREHOUSE, acting president of Drake University, Iowa, and a leader in astronomical research in America, announced a short while ago that he had discovered a new nebulous star, remarkable for the phenomenal amount of star dust—particles of matter falling through space—that surrounds it. His observations have been verified by Dr. Harlow Shapley, noted astronomer, director of the Harvard University Observatory



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Huge Floating Elevators Load Grain Ships

THESE floating elevators in the Hudson River at Jersey City, N. J., represent the most modern method of transferring grain at tidewater terminals. They are said to effect enormous economies over the old methods.

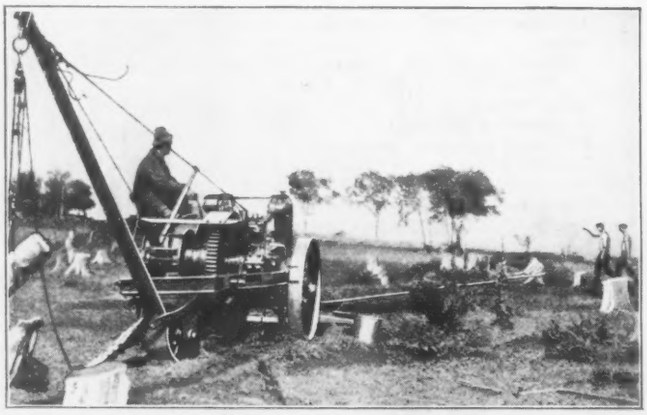
From the towering elevators the grain is loaded into ships by gravity.

Mechanical Stump Puller Anchors Itself

A STUMP puller that carries an anchor and an extra weight, and therefore need not be anchored to tree or stump, is a new invention for reclamation of waste lands.

The machine has three wheels and practically all its weight is so located as to counterbalance the pull of the cable. A heavy axle passes through the two rear wheels and supports the frame, into the rear end of which is built the anchor. Pivoting the frame over this axle forces the anchor blade to plow into the ground while the machine is pulling at the stump.

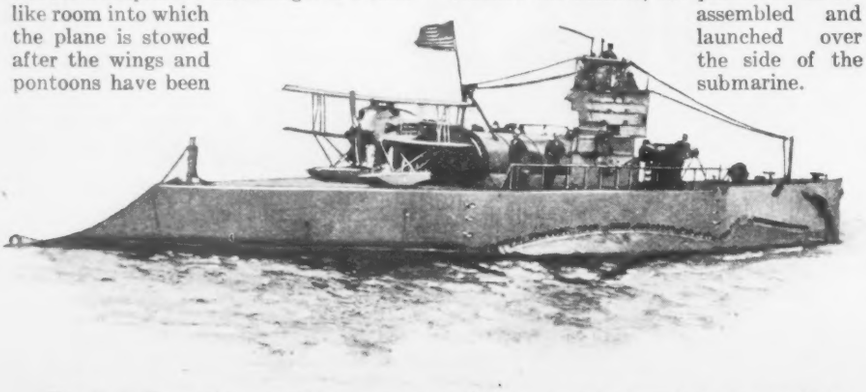
Additional anchoring weight is hung from a boom held by guy wires from the frame.



How the powerful machine anchors itself while pulling a stump

Seaplane Carried on Deck of Submarine

ON THE deck of the United States submarine MS-1 are housing facilities for a seaplane. The hangar is a tank-like room into which the plane is stowed after the wings and pontoons have been demounted from the fuselage. Within a very few minutes after the submarine has reached the surface, the plane can be reassembled and launched over the side of the submarine.



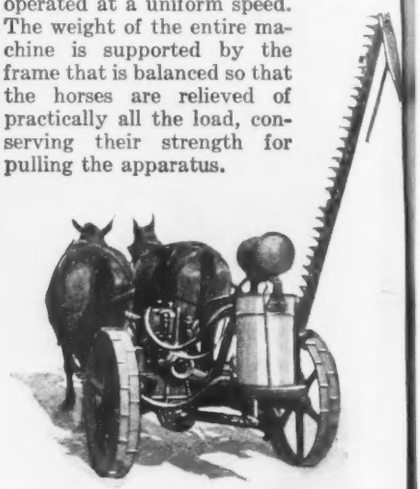
The U. S. Navy submarine MS-1, showing seaplane ready to be launched from its deck

Motor Drives Blades of Horse-Drawn Mower

A MOTORIZED mowing machine, invented by Robert C. Chattin of Mountainhome, Ida., is drawn by horses, while the mowing blades are driven by power. Power is furnished by an internal combustion engine operatively connected with the cutting blades.

This machine is said to perform the work of two horse-driven sickle or mowing machines and in a more satisfactory manner.

The cutter mechanism is operated at a uniform speed. The weight of the entire machine is supported by the frame that is balanced so that the horses are relieved of practically all the load, conserving their strength for pulling the apparatus.



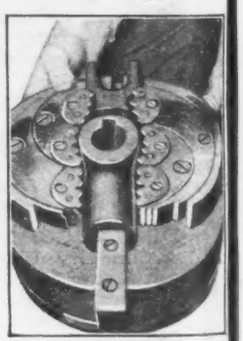
The mower with power plant

New Vise Grips Irregular Object like a Hand

A VISE that grips irregularly shaped objects with the adaptability of a human hand is an important recent mechanical development.

The vise jaws, individual pivoting semicircular segments, are said to adapt themselves to the contour of an irregular object without packing, holding it absolutely rigid.

This even distribution of gripping pressure is designed to eliminate the danger of distortion when holding thin-walled objects, as automobile cylinders, or long and narrow work. The vise is tightened by pressure exerted on the vise handle.



The jaws gripping an irregular piece

Another important feature is that the jaws, once fitted to a shape, can be tightened with screws to maintain the same relative positions. Thus, in machining a quantity of objects of the same shape and size, the vise will serve as a special fixture, holding each piece in the same position as every other piece.

A LUNAR rainbow in the form of a complete arc was observed recently during a shower at Sanderstead, Surrey, England. The moon was shining in a portion of the sky that was for the moment cloudless.

Villages Wrecked to Build 16,000-Acre Reservoir

SIXTEEN thousand acres in the Pawtuxet River valley, R. I., are being stripped of villages, factories, roads, trees, churches, schools, and cemeteries so that the city of Providence may have a 36,900,000,000-gallon reservoir.

For eight years hundreds of workmen have labored to transform this wide landscape. Steam shovels have bitten away at huge hills. Great mushrooms of sand and rock have been hurled high into the air, and trainloads of sand and rock have wound in and out among the hills. Yet three more years will be required to complete the vast project.

A Thousand Buildings Demolished

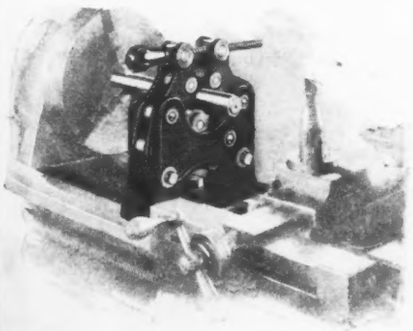
Most of the 1195 buildings condemned already have been torn down. Of these, 375 were dwellings, seven schools, six churches, and six mills. Thirty-five miles of highways will have to be relocated. The remains in the 173 burying grounds are to be reinterred elsewhere.

The site of this monster reservoir is at Scituate, about 10 miles from Providence, at a point where the valley of the Pawtuxet River huddles between towering hills. By digging away the lesser hills in the basin and allowing the high hills to serve as the shoreline, the engineers can build a dam and have an enormous basin. This main dam stretches 3200 feet from one side of the valley to the other. In some places its foundation is carried 80 feet down into solid rock. Across its top will run a wide boulevard. The dam will be 118 feet thick at the flowline and will have a 413-foot spillway. At its base it will be 640 feet thick.

At a cost of $280,000, the river's course was altered to facilitate the construction. One contract alone—that for constructing the main dam—amounted to $3,500,000.

Digging to rock bottom for a solid foundation for one section of the main dam

How the Pawtuxet River is diverted through a tunnel under the site of the dam



New Automatic Steadyrest for Machine Work

A NEW automatic steadyrest that will hold a piece of metal secure to permit a machinist to perform such operations as boring, facing, and turning at the end of the piece, has been developed quite recently by a well known Pennsylvania manufacturer.

The work is inserted from the top, and when the jaws are closed, is held by three rollers that revolve toward the center. When the work is in place, the handle end of the adjusting screw is dropped into a slot and the jaws are tightened by turning the screw.

The device may be attached easily to the lathe or removed, it is claimed. When once adjusted for the required purpose, no further alteration is necessary until a new job is handled.

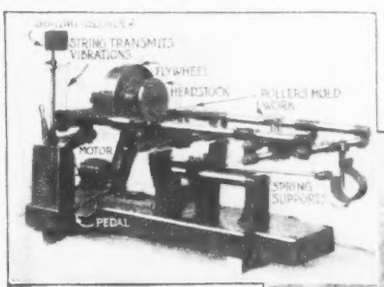
Stock of many sizes may be handled with no adjustment of the apparatus besides a few turns of the tightening screw.

Testing the Balance of Revolving Machinery

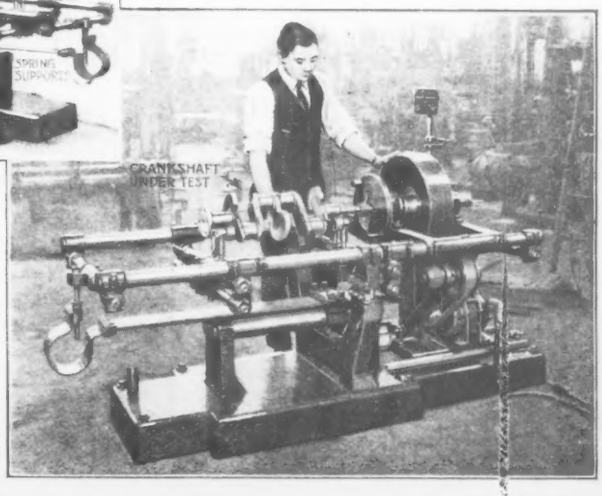
A BALANCING machine, designed for correcting the dynamic balance of machine parts in manufacture, thereby eliminating vibration in the assembled product, has been placed on the market by a Wisconsin concern.

The piece of machinery to be tested is placed in rollers in the carriage and fastened to the headstock. This headstock and the flywheel to which it is attached are turned by an electric motor. Centrifugal force tends to pull any unbalanced masses away from the axis of rotation, causing the piece of machinery under test to vibrate back and forth as it is turned. These vibrations are transmitted to a recorder by means of a string. When there are no vibrations, the piece of machinery is perfectly balanced.

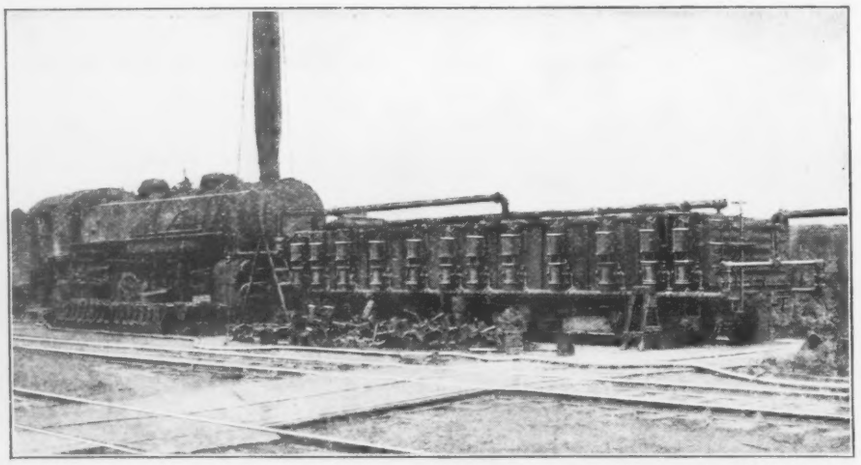
In addition, the amount of unbalance and the location of the heavy parts are determined mathematically by two tests of rotation, the necessary correction being recorded on a dial and vernier. The machine is adapted to a wide variety of work, including balancing crankshafts, flywheels, rotors, pulleys, and other revolving parts. It will receive bodies up to 24 inches in swing and 32 inches between bearings.



Above: The balance-testing machine, showing how a piece of machinery under test is fastened to headstock and revolved by an electric motor. Vibrations caused by bad balance are transmitted to a recorder by means of a string



At the right: Testing the balance of a crankshaft while in motion



Locomotive Turned into Pumping Station

WHEN the air pumps in the power house of an Indianapolis railroad shop blew a piston head, consternation reigned. New pumps could not be installed for several weeks, and without pumping facilities the men could not work. One of the engineers mastered the situation, and the serious cost of such a shut-down was spared the shop and the men.

The air pumps of 24 locomotives were fastened to the sides of a coal gondola and supplied with power by a large freight engine. Within less than 24 hours from the blowing of the piston head, full pumping efficiency had been restored.

Cigar Cutter and Knife from Old Razor Blades

OLD razor blades may be put to a dozen uses, it is said, by means of this handy pocket contrivance, designed to fit any make of blade. It folds like a jackknife, and is flat and thin, and therefore fits in the pocket without sagging or bulging it.

Besides serving as a pocket knife, it has a round opening placed so that when the knife is closed, the blade serves as a cigar cutter. Another opening is provided for cutting string on packages—often dangerous with an open blade.

A notch in the handle can be used as a handy bottle opener, while a pointed corrugated lever on the blade-holder serves as a nail file or match striker when the device is closed. Extending this lever supplies the user with a nail cleaner and a piercer.

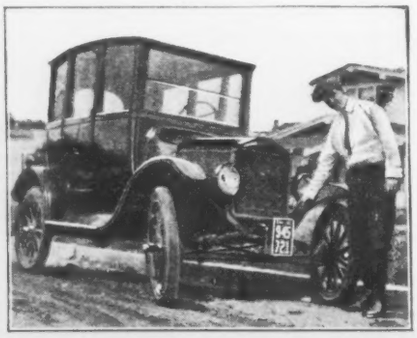
Safety razor device used as cigar cutter

Hole in License Plate to Foil Thieves

AN AUTOMOBILE license plate with a large square cut out would be almost certain to attract the attention of a policeman immediately. On this fact Jons Nelson, of Los Angeles, Calif., based his invention of a new anti-thief device.

An auto driver, when leaving his car, detaches a rectangular section cut from the center of the plate, as shown below. When he returns, he inserts the missing piece. Both operations are simple and quickly accomplished. An electric alarm reminds the driver if he forgets to put back the missing portion.

The theft signal plate with section removed



License plate with cut-out section replaced

Trousers Pressed Quickly by Electric Valet

AN ELECTRIC valet which, when attached to an electric-light socket, is claimed to press a pair of trousers in the time it takes a man to shave, is one of the latest of home electrical appliances.

It consists of three flat units—a top, base, and pressing pad. The pad is equipped with a thermostat that shuts off the current when the correct temperature has been reached, thus preventing overheating and scorching.

Current from light socket presses trousers

To press the trousers, the heating pad is dampened evenly on both sides with a moist rag. Then one leg of the trousers is spread out, smoothed and stretched on the base so that the cuffs extend over the edge. The pad then is placed over the leg and the second leg is placed on the pad. Over all the top is laid and fastened by clamps. Finally, the current is turned on.

It is claimed that only 12 minutes are required to press light summer trousers, and from 15 to 20 minutes for heavier trousers. The cost of one pressing is said to be about two cents.

Simple Door Guard Locks Key to the Knob

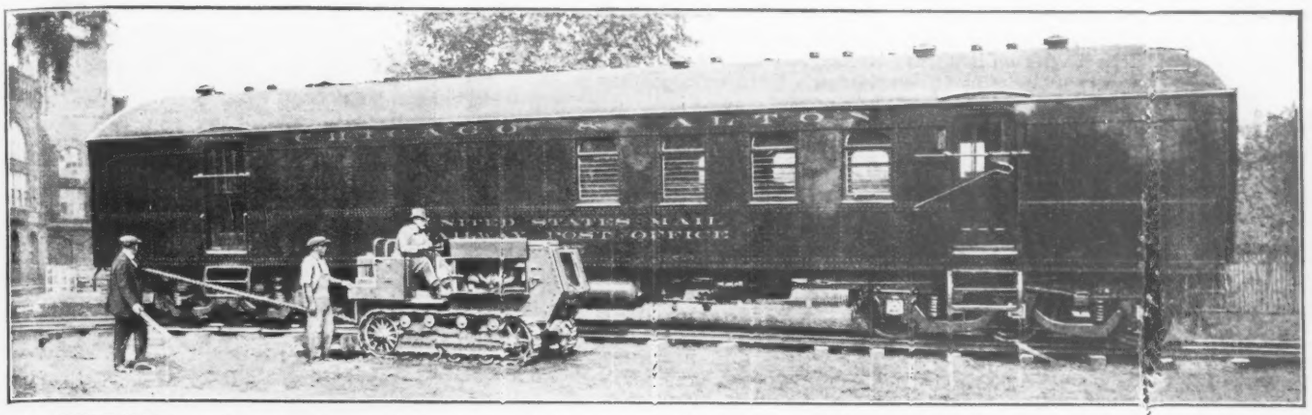
THE inventor of this simple doorkey guard claims that no burglar can push in the key of a door equipped with the device, and insert his own. One end of the guard encircles the neck of the doorknob and the other end passes through the eye of the key. The key then cannot be turned nor pushed out by an unwelcome intruder.

How the key is locked to the doorknob

The guard is made in two models—one that can be opened and detached, the other permanently closed, requiring removal of the knob to detach the guard.

TO TELL whether fabric contains sizing to improve its appearance, boil a piece of the goods. This brings out the sizing.

Five-Ton Tractor Tows 160-Ton Railway Mail Car



A FIVE-TON endless tread tractor coaxed a 160-ton mail car over 400 feet of temporary track from the main line of the Chicago & Alton Railway recently for exhibition at an Illinois fair. The ponderous load taxed the little tractor to the limit for four hours to accomplish the feat. A stout chain was made fast to the rear of the car and the powerful tractor tugged alongside, pulling the heavy car like a tugboat towing an ocean liner into its waiting dock.

Would Dye Motor Gasoline Red for Safety

FOLLOWING a study of the hazards of gasoline, the United States Bureau of Mines has suggested that all motor gasoline should be colored red as a safety measure against mistaking it for water, kerosene, or other colorless liquids.

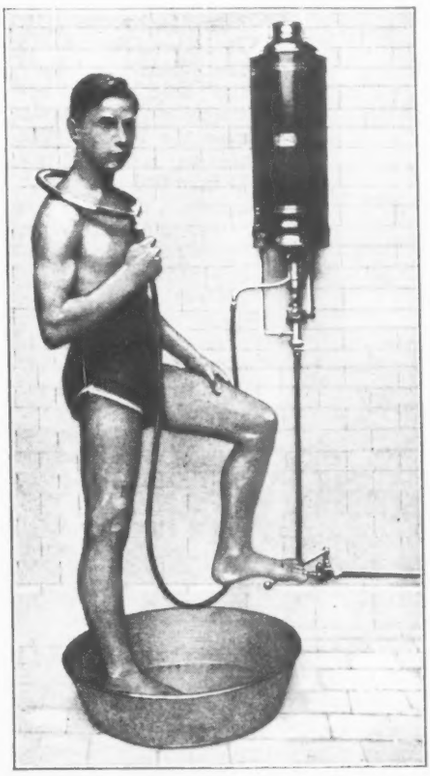
The Bureau has found that one ounce of dye is sufficient to color 1000 gallons of gasoline.

Midget Vacuum Cleaner Is Clothes Brush

A THREE-POUND vacuum cleaner that can be operated by one hand, has been invented for removing dust, lint, and ravelings from clothes, hangings, automobile interiors, upholstered furniture, and similar surfaces inaccessible to the usual full-size cleaner. A stiff brush attachment is provided for cleaning billiard tables, walls, and other solid, flat surfaces.

The device collects dirt and is emptied like the usual cleaner. It is said to exert ample suction for any of the purposes enumerated.

Vacuum cleaner used as clothes brush



Simple Home Shower Bath Is Easily Installed

A HOME shower bath, usually considered a luxury, is said to have been made available at a cost far below that of built-in fixtures by a newly invented apparatus designed for use with a small gas water heater.

A foot control regulates the gas flow and hence the water temperature. Another model of the same device attaches to the faucet of a bathtub where one faucet discharges both hot and cold water.

Perforations in the lower half of the shower ring produce scores of tiny streams. There is a steady, generous flow over the whole body, yet the hands of the bather are left free. The hair cannot be wet, as under the ordinary shower.

Cigarette Lighter Uses Spark and Benzine

BENZINE and an electric spark are substituted for matches in this cigarette lighter. The tipped cylinder shown in the right hand holds a wick and benzine. When a light is desired, the tip is touched to two metal strips shown beneath the flame. A spark from a battery within the device lights the benzine-soaked wick at the tip of the cylinder.

Fume Masks for Painters

RESPIRATORS and rubber gloves are being adopted in England to protect painters from lead poisoning and other ills to which they are otherwise exposed in working with paints and varnishes.

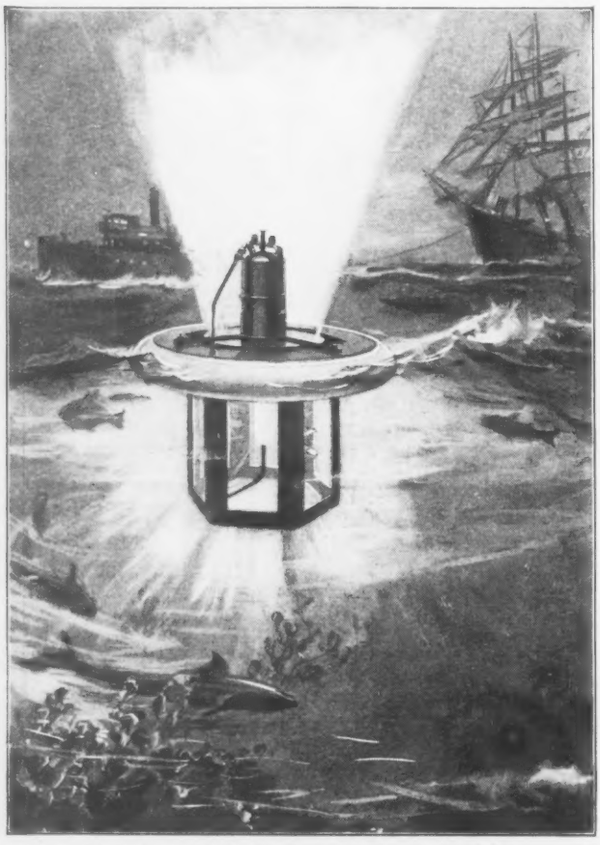
Protected by mask and rubber gloves

Lantern Light Is Bait for Fishes

ON CALM nights along the shores of the Mediterranean, fishermen often may be seen using the light from lanterns to attract the fishes. Remaining in a shadow, they wait until the fishes come close enough to the boat to be harpooned with tridents.

Adopting the same principle, two French naturalists, MM. Fage and Legendre, have devised an ingenious lantern to assist them in their zoologic researches by projecting light into the water. It is designed to attract the millions of small fish and marine animals that infest the waters of certain regions, to illumine them so that they may be observed and studied in their native haunts. It works the same as the old-fashioned lantern but, of course, is more efficient.

The lamp consists of a six-sided box with six windows. This box is about 18 inches high and is suspended from a circular float 27½ inches in diameter. On top of the lantern is mounted an acetylene gas generator, from which the gas is conducted to a burner tip near the bottom of the box.

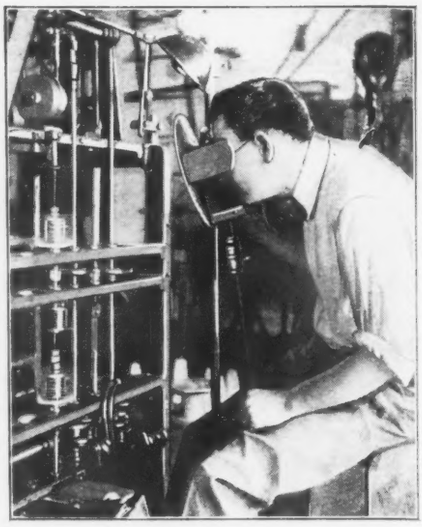


Light from the floating lantern attracts the fishes

Two boats holding a net between them can surround the space in which the lantern floats and capture all the fishes, large and small, that have been attracted by the light. It is possible also to float the lantern near the shore and attract the fishes that remain near the beaches. In this way a dragnet can be used to haul the fish ashore.

The use of acetylene is especially advantageous because water is the element that produces the gas. Thus, even if the generator is completely submerged, it will cause no harm. Instead of using a cork buoy the float may be built of metal, making the air chamber watertight.

The apparatus, it is said, can be used for both scientific and commercial purposes.



Speeding Machinery Made to Appear Motionless

MACHINERY speeding at many thousand revolutions a minute, can be made to seem motionless or to appear to be moving at any desired speed, it is claimed, by a new electrical observation instrument called the rotostat. High speeds are thus made to yield to mechanical analysis.

The device is connected with a light socket and two knobs are turned until the machinery under observation appears stationary or moving at the speed desired by the observer. A lamp and reflector are mounted on an adjustable standard with the machine.

Errors in timing of interlocking parts, unexpected interference, deformation of parts under centrifugal stresses, and speed variations are said to be revealed clearly by the instrument.

The photograph above shows an observer studying the operation of a magnet wire insulating machine that is applying a double cover of silk to copper wire at a speed of 4000 r.p.m. He sees each wrap of silk as it is wound on the wire.

How to Photograph Panorama with Ordinary Camera

MOST amateur photographers will be surprised to learn that excellent panoramas can be photographed with an ordinary camera. The remarkably fine picture below is striking evidence that the feat is possible.

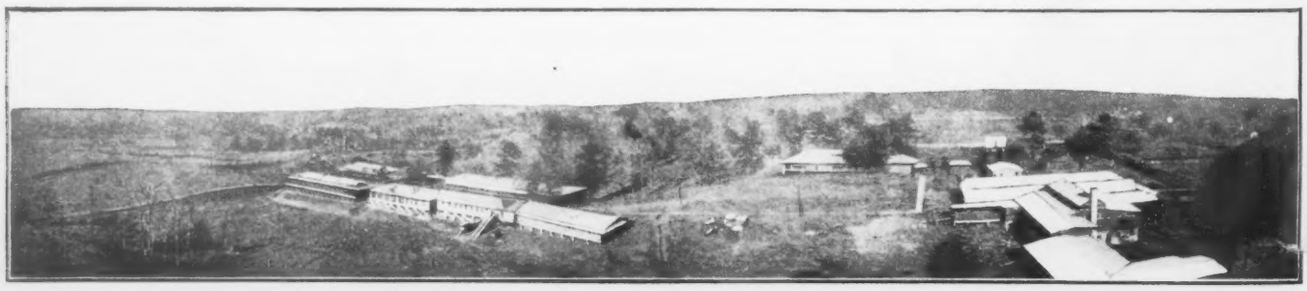
It was taken from the top of a 125-foot tower with a 2¼ by 3¼ folding camera and included approximately one quarter of a mile of lateral distance. Note how perfectly skyline, roads, and buildings match, attesting the astonishing accuracy of the method.

To take similar pictures you need, besides the camera, only a stationary tripod or some other object upon which the camera is mounted solidly while being permitted to swing from side to side. The regulation telescopic tripod is ideal for the purpose, since the thumbscrew may be loosened, allowing circular motion while still holding the camera firmly.

When the camera is in position, take an exposure of one extremity of the panorama desired. Now swing the camera, not the tripod, toward the center of the panorama, allowing a tiny strip of the previous view to show in the view finder. Change the plate or film and make another exposure.

Succeeding sections of the panorama are made similarly.

The films may be cut and matched when dry or separate prints can be made. For ordinary pictures, the regular stop and snapshot one fiftieth of a second exposure is sufficient. In views like the one below, it is best to use the smallest stop and short time exposure.

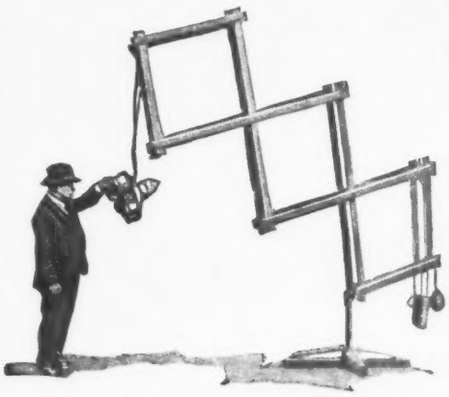


Lake Invents "Lazy Tongs" to Hold Heavy Tools

TO AID workmen in lifting and carrying heavy tools and other objects, Simon Lake, noted inventor of submarines, has devised what he calls a "gravity eliminator." It is a series of jointed levers—actually a "lazy tongs" mounted on a pivot, so that, when extended, the long end always will be twice the length of the short end.

From the short end is hung a weight sufficient to balance a cement gun, riveting hammer, air or rock drill, or whatever heavy tool may be attached to the long end. The effect is that a tool that actually weighs 50 or 60 pounds seems to float in the air, relieving the workman of the muscular effort of supporting it.

The extensibility of the device and the fact that it swings on a pivot give the workman a wide latitude of movement, says the inventor.

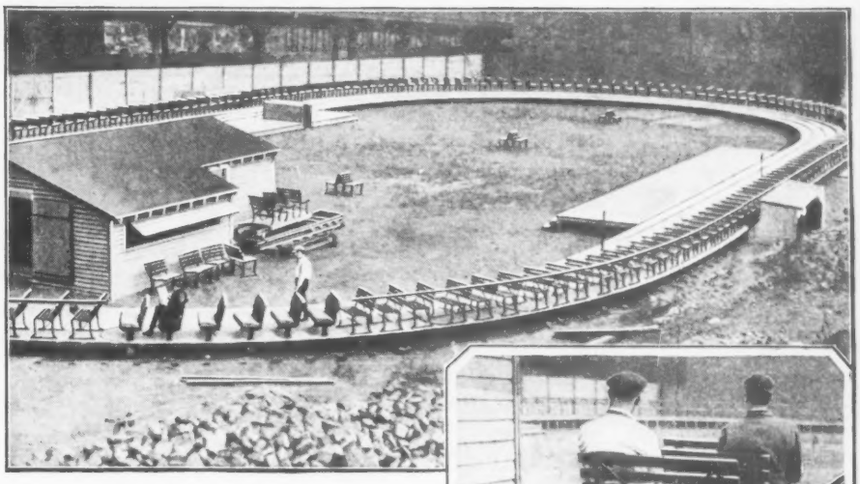


Simon Lake, famous inventor of submarines, demonstrating his "gravity eliminator"

Garage Doors Opened by Weight of Auto

AUTOMATIC garage doors, recently perfected, are opened by the weight of a car as it approaches on a special runway. After the car has entered, counterweights close the doors. They cannot close while the car is on the runway or threshold, the inventor claims. Any sized garage can be equipped with the invention, it is said.

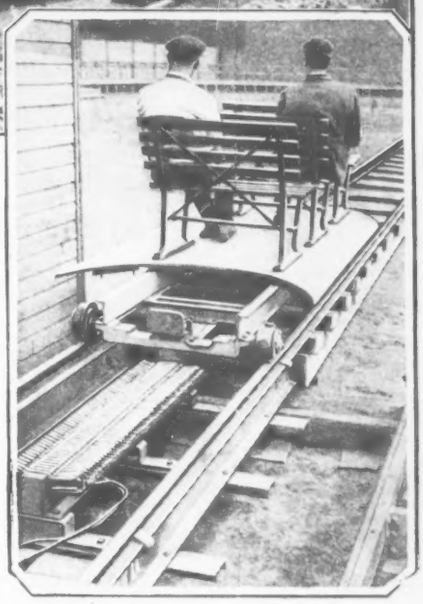
Weight of car on runway opens doors



Moving Walks Designed to Solve Traffic Problem

A UNIQUE three-speed moving "walk" soon may replace the shuttle subway trains that make the three-minute run between Times Square and Grand Central Station, in New York City. The pictures show a model being tested in a field at Jersey City, N. J.

The "walk" will consist of three parallel platforms running at three, six, and nine miles an hour respectively. It will run in a continuous loop. Passengers step from a stationary platform at each terminal upon the three-mile-an-hour platform, from this to the six-mile platform and thence to the last, upon which are seats. An electromagnetic power plant operates the carrier.



Above is a section of the model moving walk, showing the electromagnetic drive

Realistic Ocean Breezes from Vacuum Cleaner

OCEAN breezes, or at least deceptive imitations of them, are said to be obtainable from the household electric vacuum cleaner at about two cents an hour.

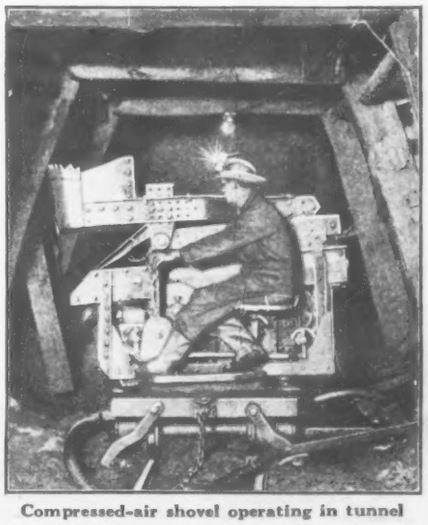
The bag and driving belt of the cleaner are removed and a sponge soaked in salt water is placed in the suction end. The effect of sea cliff breezes is heightened by placing the converted vacuum cleaner in an open window.

A NEW preparation to prevent clouding of auto windshields, perfected by the Navy Department, consists of a sodium salt of sulphonated rapeseed oil, with an excess of caustic soda and a small amount of waterglass, glycerin, and engine oil.

Compressed Air Drives Midget Power Shovel

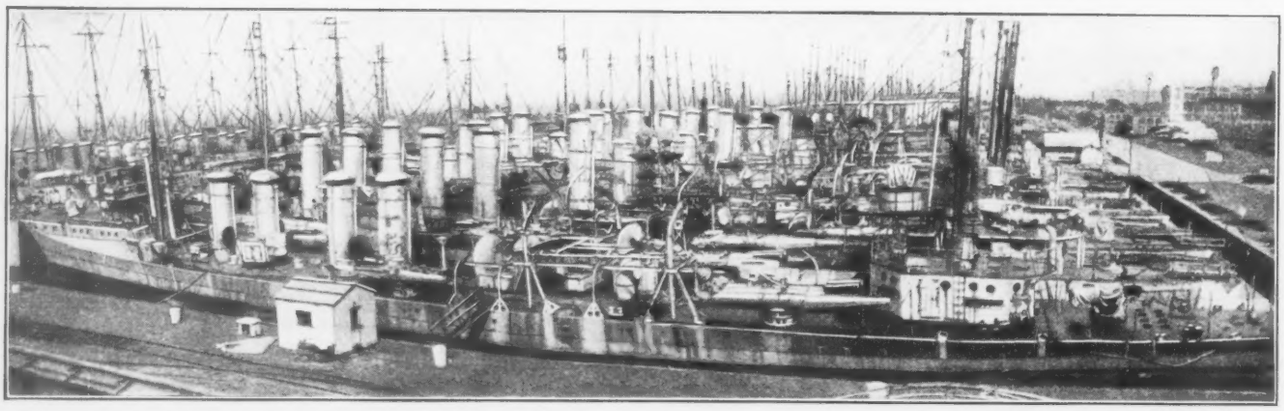
A COMPRESSED-AIR power shovel only 5½ feet long and operating on an 18-inch track is coming rapidly into use for work in cramped quarters, such as tunnel digging.

The shovel superstructure is carried upon a specially designed ball bearing. The swinging engine is vertically mounted and swings the shovel through a complete circle. No clutches are used, the engines being reversible while running at full speed and controlled by operating levers.



Compressed-air shovel operating in tunnel

Where Acres of U. S. Destroyers Rust in Navy Yard



THIS remarkable view of the League Island Navy Yard, Philadelphia, Pa., shows how more than 100 destroyers, built by Uncle Sam at a cost of about a million dollars each, lie huddled along the docks like sardines, gnawed by the elements.

Rusting beside them is a row of nine battleships, a number of Eagle boats and other wartime auxiliary craft. The government has advertised many of them for sale. Those not sold will be scrapped.

Taking Dictation through Office Loudspeaker

TAKING dictation from a loudspeaker is one of the new experiences of the stenographer in a modern office. The business man who is dictating the letter sits in his office in another part of the building and speaks into a telephone transmitter. The loudspeaker carries his words clearly to the stenographer, who transcribes them—a method that saves time all around.

Builds Novel Diving Suit from Old Boiler

IMPROVISING a diving apparatus from an old household hot-water boiler, 15 yards of rubber tubing, a length of heavy chain and a discarded beer pump, Walter Merwin, of Perth Amboy, N. J., has become a successful commercial diver.

He is the submarine member of a firm that salvages metal junk from vessels about to be scrapped. The inventor claims he can make deep dives with this rough-and-ready "suit," and that his homemade outfit is safe enough for him.

Walter Merwin and his ingenious diving helmet made from an old boiler

At the left Merwin is shown submerging for salvaging operations, using his odd homemade diving apparatus. Note the old beer pump used to supply air to the helmeted diver through 15 yards of rubber tubing. Note also the window cut in the side of the old boiler

New Piano Keyboard to Simplify Fingering

THE keyboard of the modern piano is an unaltered heritage from the instrument of several centuries ago. Novices and virtuosos alike have been aware of its limitations for fingering, but seem always to have reconciled themselves to it.

Now, at last, the straining, athletic fingers can relax, according to Dr. Moriz Stoehr, professor of bacteriology at Mt. St. Vincent College, New York. He has invented a scientific keyboard, with which, he claims, novices may save many of the weary hours of finger exercises. He also claims that pianists may create tonal beauties heretofore impossible.

The only visible difference between the new keyboard and the conventional one is the shorter length of the black keys. These do not extend all the way back to the fallboard, as in other keyboards, and the white keys widen to full width again behind them. This makes available a second row of white keys.

The new keyboard can be installed in a standard piano in a day, without structural changes in the instrument, the inventor asserts.

Radio Tubes for Autos

THE automobile engineer has added the vacuum tube, the miracle worker of radio, to motor-car equipment.

With vacuum tubes to control the ignition, the timing of the spark and its duration is said to be controlled accurately without the usual complicated adjustments necessary with present types of generators and interrupters, and without constant adjustment to counteract the effects of wear and tear on interrupter contacts and mechanism.

Weight of car on runway opens doors

of waterglass, glycerin, and engine oil.

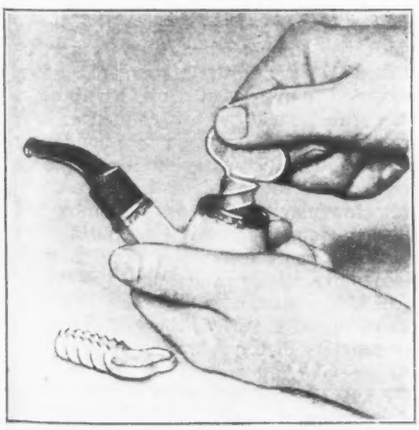
Compressed-air shovel operating in tunnel

This Milk-Can Cover Is Operated by Pedal

AN INVENTIVE Indiana farmer has devised an effective apparatus to keep the milk in his cans free from the dust and insects that invariably invade even the most sanitary dairy barns.

It consists of a broad cloth-covered lid of wood that rests on top of the strainer above the can while the milking is in progress. To pour his pail of milk into the can, the milker simply steps on a pedal, indicated by the arrow, which swings the lid upward and backward.

Handy Reamer Cuts "Cake" from the Old Pipe



DEVISED on the theory that the "cake" in pipes, contrary to the rooted conviction of thousands of smokers, taints rather than improves the taste of tobacco smoke, this augerlike cleaner cuts and bores out the charred accumulation. The reamer is inserted in the pipe bowl and slowly turned, scraping out the cake easily.

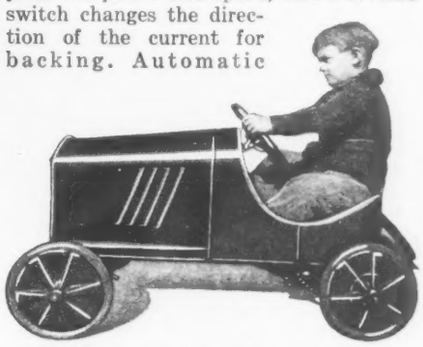
Most pipes are boiled in oil before they are finished, to prevent to some extent the formation of cake.

Iowa Boy Drives Midget Electric Auto

NEARLY every small boy has dreamed of owning a real automobile—one that really runs by itself. For the six-year-old son of Ralph Frick, of Burlington, Ia., this dream has come true. His father has built him a midget electric car that makes 12 miles an hour on the level, has automatic brakes, disk wheels, and a self-starter, and weighs 70 pounds.

At a state fair this play auto pulled a 2½-ton brougham several hundred feet in front of the racetrack grandstand. Yet, for all its power, and its detailed resemblance to full-sized models, the car embodies safety in a remarkable degree.

Electric power is generated from a four-cell battery under the hood, which runs the car 20 miles without need of recharging. Under the seat and connected with the rear axle is a self-starter. An electric spring shut-off accelerator adjusts the power and speed, and a reverse switch changes the direction of the current for backing. Automatic brakes and an emergency brake are provided.



This Iowa boy drives his own electric

To start, the child places his foot on the self-starter button, transmitting power to the driving apparatus on the rear axle. When the foot is removed, the power instantly is shut off and the automatic brakes are applied. The back wheels immediately lock, so that even on a hill the car stops.

Horse Dines in Comfort from New Nose Bag

INVENTIVE ability and a love of horses combined to perfect this feed bag.

The old type of bag made simultaneous eating and breathing painful and sometimes barely possible for a horse. Moreover, in the struggle, the hungry animal often lost an exasperatingly large portion of his oats. The new bag has a reservoir on each side, from which the feed drops into the nose portion as this container is emptied. The roominess of the bag permits the entry of plenty of air for the horse to breathe.

The Women's League for Animals is responsible for the perfection of the bag and is urging its universal use.

GOVERNMENT hunters now use catnip to lure bobcats and mountain lions into traps.

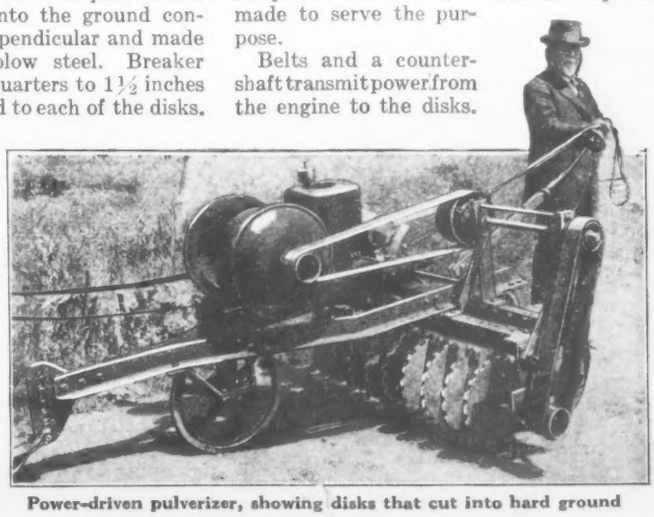
Disk Plow Designed to Break Hard Ground

A POSSIBLE solution of the plowing problem on hard ground is seen in the invention at San José, Calif., of a dust mulch pulverizer. The part of the machine that cuts into the ground consists of disks, set perpendicular and made of one-fourth-inch plow steel. Breaker cutters from three-quarters to 1½ inches in width are attached to each of the disks.

The disks turn independently of the plow's speed, and revolve 250 times a minute. They cut into the ground from two to 12 inches, and are raised or lowered according to the depth of cut desired. The disks may be from 16 to 24 inches in diameter.

The pulverizer is driven by a 1½-horsepower gasoline engine mounted on a frame above the disks. It is drawn ordinarily by a horse, but with a universal joint attachment, a tractor may be made to serve the purpose.

Belts and a countershaft transmit power from the engine to the disks.



Power-driven pulverizer, showing disks that cut into hard ground

© Keystone

Radio Watch Sets Itself by Time Signals

A RADIO watch apparatus that automatically sets the hands each noon when radio time signals are broadcast, has been invented by Lt. John Iseman, of the United States Navy, shown above.

The outfit consists of a miniature radio receiving set with a fixed wave length of 455 meters, a fixed cartridge detector, and a "self-restoring coherer" that closes the circuit between a small storage battery in the set and a sensitive relay ingeniously built in the watch.

The escapement wheel has as many teeth as the number of dots that are transmitted during the five-minute period in which time signals are broadcast. This wheel is rotated, one tooth for each signal sent, until the snap mechanism for setting the hands—as in a stopwatch—is released and the hands snap to noon.

A tiny aerial, 30 feet of gold-plated wire, is within the case of the set.

Crystal Set Is an Ashtray

A BUSY radio fan, whose desk was too crowded to give room for both an ash holder and a receiving set, conquered the problem by combining the two.

This little instrument has a crystal detector and a specially wound coil, atop of which rests the ash receiver. The set is connected with a light socket, the latter serving as an aerial.

Listening in with the ashtray receiver

New York Police Operate a Broadcasting Station

RIVALING the most powerful and elaborate broadcasting stations in the United States, New York City police headquarters station is a powerful ally of the law.

Broadcast descriptions of criminals and missing persons, it is believed, will place hundreds of thousands of persons on the alert as posters and handbills never could. Following fires, wrecks, or other severe disasters, the station will broadcast the names of all casualties, thus avoiding a flood of calls to the police from anxious friends and relatives.

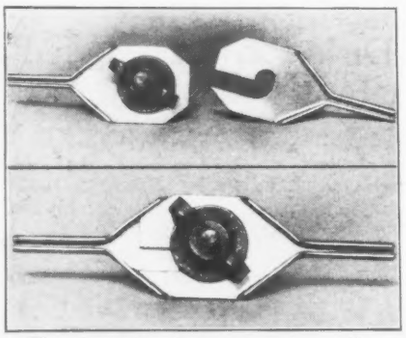
When not in use for such purposes or serving in interdepartment communication, the station will broadcast concerts by the Police Department band, lectures bearing on matters of civic interest, and other programs.

© U. & U.

Broadcasting station in police headquarters

Simple Clamp Takes Place of Lightning Switch

ALTHOUGH the only lightning safeguard required by the Board of Fire Underwriters is an arrester connected across the lead-in and ground wires of a radio outfit, many radio owners choose to take the extra precaution of connecting in a lightning switch so that they may be certain of a positive connection between the aerial and the ground.



The wingnut makes a strong connection

A simply constructed clamp that meets this need while obviating the standard lightning switch, is shown in the illustration above. Connection is made by slipping the slotted member into the projecting screw of the other member and tightening down with the wingnut. The bayonet joint makes a strong connection.

Eiffel Tower Model Holds Powerful Receiver

THIS model of the famous Eiffel Tower, of Paris, serves as a novel and decorative radio set of the three-circuit regenerative type. The receiver has two stages of audio amplification, permitting the use of a loudspeaking horn.

Lubricating Switchpoints

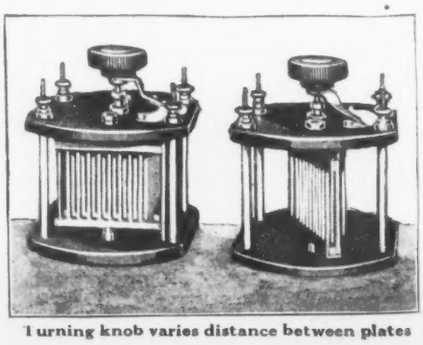
A LITTLE vaseline rubbed lightly on the switchpoints of the radio receiver will make the arm slide easily over the points and obviate any chance of friction wearing down the points.

New Variable Condenser

THE latest wrinkle in variable condenser construction comes from France. Every radio fan is familiar with the standard type of variable condenser in which the change of capacity is accomplished by varying the amount of surface presented to one set of plates by another.

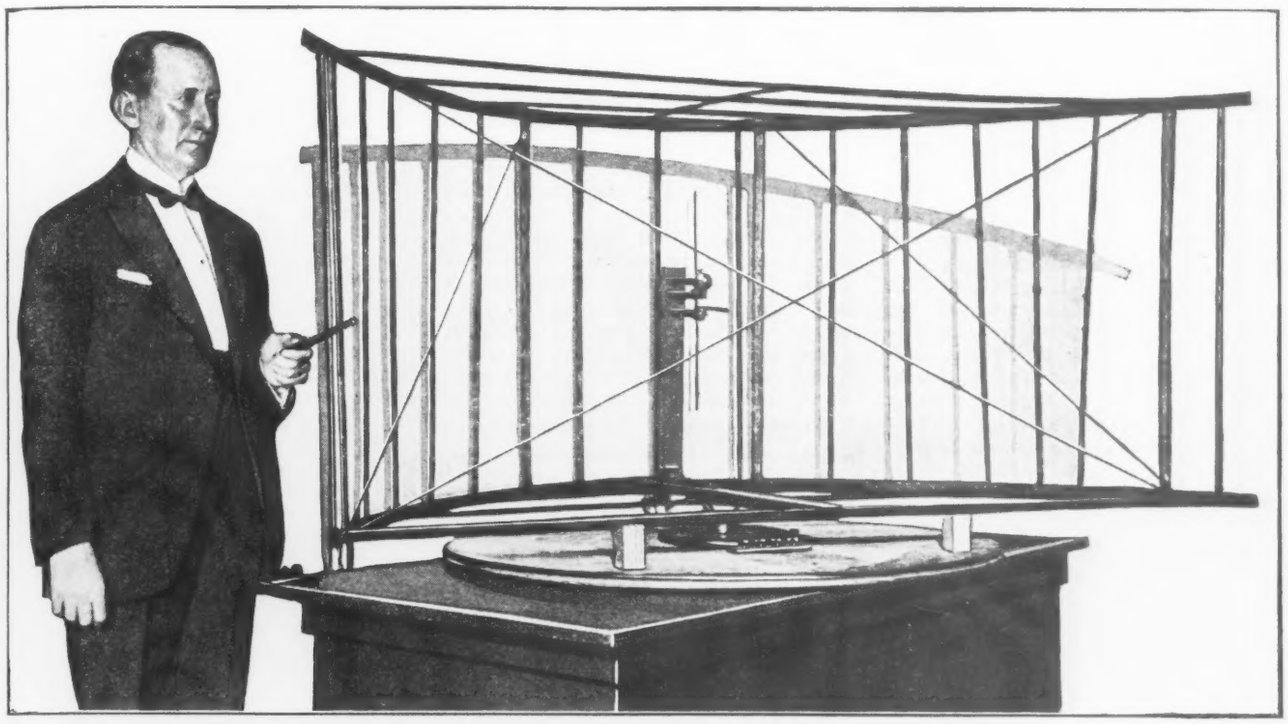
In the new type of condenser the principle that the capacity of a condenser can be changed by varying the distances between two sets of plates is utilized.

Rectangular plates are so mounted between four horizontal supports that when the central knob, connected with these supports by a linkage system, is turned, the distances between the two sets of plates is varied, thereby changing the capacity of the instrument.



Turning knob varies distance between plates

Secrecy in Directed Radio



Senator Guglielmo Marconi, discoverer of wireless transmission, and his "radio searchlight," an antenna reflector with which he has succeeded in throwing a powerful beam of radio waves in any given direction, in the same manner that a mirror reflects a beam of light

By Jack Binns

America's Most Popular Writer on Radio

A FEW weeks ago Signor Marconi announced that radiotelephone communication had been established between England and the Canary Islands—over a distance of about 2000 miles. While on the face of it there was nothing extraordinary in this statement, it encompassed an achievement of tremendous importance in world communication; for the long-distance messages were directed to a specified point under conditions that practically insured secrecy from all radio receivers except the one for which the messages were intended.

The "Radio Searchlight"

The success of this long-distance test was the result of Marconi's continued experiments with the "radio searchlight," by means of which he focuses radio waves in a powerful beam in a definite direction. Direction of the waves is accomplished by means of an antenna reflector that throws a beam of radio waves in much the same manner that a hand mirror throws a beam of light waves.

In conjunction with other experiments along similar lines, Marconi's announcement would seem to indicate that commercially practical application of secret radio is not far distant.

Recent experiments to achieve complete secrecy have followed three distinct lines, as follows:

1. Reflected waves of tremendously high frequency, directed as a radio beam toward a specified point.

2. Obtaining secrecy by means of suppressing the carrier wave and one of the side bands.

3. Deliberate "scrambling" of speech in transmission so that only a receiver especially designed to translate it can understand the message.

The first type of experiment is being followed by Marconi and British experimenters associated with him, while the second and third types are being pursued by American experimenters. By a strange coincidence, the first two offer the advantage of requiring less power than is normally necessary to cover a specified distance.

The success of Signor Marconi's reflection method depends upon a principle made practical by the development of the vacuum tube and the super-heterodyne receiver. There is a certain romance about this system, for it was the very first employed by Marconi in the late '90's when he startled the world by communicating between two points without the aid of connecting wires.

Almost Missed Broadcasting Marvels

Experiments previous to his own had determined the fact that reflection of electromagnetic waves was just as feasible as the reflection of light waves. With this in mind, Marconi set about to develop such reflectors, employing them at the transmitting and receiving ends of his apparatus. By doing so, he almost missed the wonderful possibilities that radio opened by its very ability to broadcast in every direction, without which communication between ships would have been utterly impossible. But the crude apparatus in use in those early days precluded the development of reflected waves. As a result, Marconi turned his energy to perfect and extend ship communication.

Shortly before the war, however, Marconi again reverted to his first love, investigating its possibilities upon extremely short waves where the frequencies involved run above the 100,000,000 a second mark. At first he used spark transmitters, and achieved some slight success, but real results did not materialize until the oscillating vacuum-tube circuit was discovered.

Great Progress in Radio Reflection

Tremendous strides in the reflected-wave system of communication in the past two years have been made possible by the regenerative circuit and the super-heterodyne principle. The former is used in transmission and the latter in reception. The system of reflection, however, is Marconi's own, developed by him and his assistants, chief of whom is C. S. Franklin, a prominent British radio engineer.

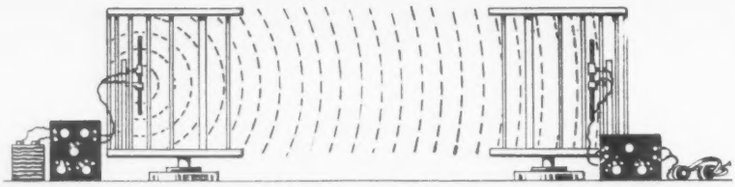
Secrecy in reflected waves lies in the fact that the waves, instead of being broadcast in every direction, are concentrated in a single beam by suitable reflectors, then shot forward in a direct line between the transmitter and the receiving apparatus. Naturally such a beam is governed by the laws that govern reflected light beams—the farther it travels from the producing source, the more the beam broadens.

Only a receiver that is in the path of this reflected beam can intercept the message it carries. Even then, the

receiver must be especially designed to respond to such terrific frequencies.

Marconi's recent successes over vast distances with this system have been achieved by painstaking development of the antenna system used with the receiving apparatus. He found that if at the receiving end he used a radio mirror that was a replica of the one employed at the transmitting station, signal strength was increased materially and greater distances could be obtained.

Perhaps there is an analogy between the radio reflector and the gigantic reflector mirrors used in large astronomical observatories to pick up and concentrate the weak light-wave energy received from distant stars, which could not be seen by the unaided human eye. The ordinary radio receiver in this case could be likened to the unaided eye, while Marconi's receiving apparatus would correspond to the giant reflectors.



This diagram illustrates Marconi's system of directed radio. Instead of being broadcast in all directions, radio waves are concentrated by an antenna reflector (at the left) into a radio beam which is directed toward receiving antennae

A Second Method for Secrecy

In my opinion, the second system I have mentioned—that of obtaining secrecy by suppressing the carrier wave and one of the side bands—offers even greater possibilities with fewer drawbacks. Reception in this case can be obtained only with a receiver equipped to provide the missing frequency of the suppressed carrier wave by means of a local oscillator.

In addition, the system requires what might be termed less space in the ether, thereby making available a larger number of channels for communication. This is a particularly valuable consideration for commercial transatlantic communication. In such transmission only long waves are available; and since the frequency difference between any two sets of long waves is very small, the number of channels available is very small.

As an illustration, suppose we take a 5000-meter wave (the one that has been used in the actual experiments). Such a wave has a frequency of 60,000 cycles a second. A wave of 6000 meters has a frequency of 50,000 cycles a second. Thus, while there is a difference of 1000 meters between these two waves, the frequency difference is only 10,000 cycles. This means that if both of the carrier waves and their side bands were radiated at the same time, the lower side band of one wave would interfere with the upper side band of the other.

Prevents Interference

The system of suppressing the carrier wave and one side band would prevent such interference. In addition, there is the added advantage of secrecy obtained by the absence of the carrier and one of the side bands. Of course, absolute secrecy has not yet been attained by this method. It is possible to receive such signals on any oscillating regenerative receiver, yet the speech so received is more or less distorted, assuring a certain measure of secrecy.

While experiments with the system have been restricted to transoceanic communication on fairly long waves, there is no reason why they should not be applied to telephone communication across land spaces with small power and on short waves, along the lines that govern amateur radiotelephone transmission. The transatlantic experiments have been conducted from the huge radio transmitting station at Rocky Point, L. I., where high-powered water-cooled vacuum-tube amplifiers are employed.

ARE you getting the most out of your radio receiver? Or is there some elusive imperfection that limits the range of your radio pleasure? Next month Jack Binns will reveal secrets of selecting and operating apparatus and circuits that will help you bring your set up to maximum efficiency.

The transmitting apparatus consists of two modulators, two filters (which eliminate the carrier and one side band), and three amplifiers. After the filtration has been completed, the output is passed through the first amplifier with a power rating of 750 watts, then through the second, which has a power of 15 kilowatts, and finally through an amplifier with a power of 150 kilowatts, which has been found sufficient to transmit signals across the Atlantic in daylight. An idea of the tremendous amount of this power can be obtained by considering that in the average first-class radio broadcasting station, only one half of a kilowatt is employed for radiation purposes.

In transatlantic tests during the past year, interesting data was obtained. From experience with transatlantic radiotelegraph work, it was expected that daylight reception would be more difficult than the night transmissions. This was verified by actual experience.

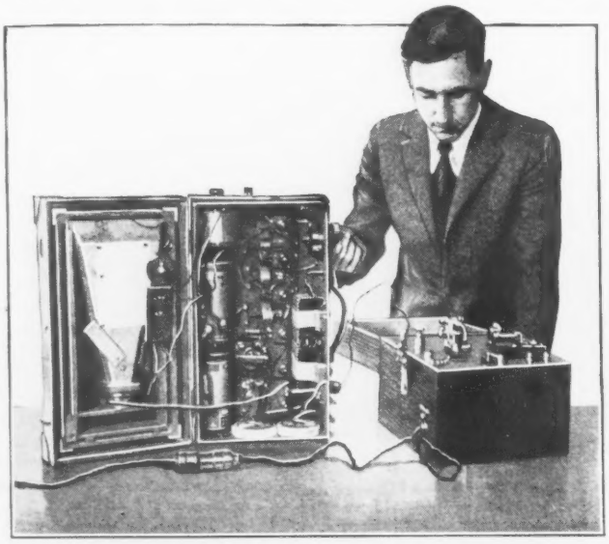
Tests were made every hour of the day for a period of 12 months, and a careful record made of the signal strength, as compared with the strength of interfering noises such as static. The results obtained were then plotted on curves, so that it was possible to get a clear idea of conditions.

New Facts about Reception

It was found generally that reception in the winter months in England was best just before daybreak. Strangely enough, it was found that in the summer months the best reception occurred a few hours after daybreak in England.

One of the interesting points brought out by the experiments is the fact that reception is neither very good nor very bad during the three hours when business is in full swing both in London and New York City. This occurs between the hours of nine o'clock in the morning and noon, New York time.

Reception is accomplished with a specially designed super-heterodyne receiver with which a local oscillator is connected for the purpose of supplying the frequency corresponding to that of the missing carrier wave. The key to the whole system is the missing frequency that must be produced locally in order to obtain satisfactory and undistorted reception.



One of the most noteworthy of recent contributions to the development of radio communication is an instrument that is said actually to record spoken words received by wireless. It is the invention of Francis Dunmore, of Washington, D. C., who is shown above with his creation, known as a radio relay recorder. He claims it makes possible the distant control of any mechanism by radio

"Scrambling" Messages

The third system mentioned at the beginning of this article is that of "scrambling" the message that is being transmitted. It is based on the idea of deliberately distorting speech in the modulating system before the voice currents are impressed on the transmitter. A receiving set designed to pick up the messages would respond to the distorted vocal frequencies, make the necessary allowances and reproduce perfectly understandable words.

Should this system prove successful eventually, it could be applied readily to either of the other two systems described. In fact, there is no reason why all three systems should not be merged—when they have completely passed out of the experimental stage—into one absolutely accurate system of secret communication.

How to Build a Neutrodyne Set

The Most Authoritative Article on the Subject Ever Published

Approved by Professor Louis A. Hazeltine, Inventor of the Circuit

By J. F. Dreyer, Jr.
Engineer of the Hazeltine Research Corporation

J. F. Dreyer, Jr., at work in the electrical laboratory of the Stevens Institute of Technology, Hoboken, N. J., adjusting the neutralizing condenser of the standard five-tube neutrodyne receiver described by him clearly and interestingly in the accompanying article

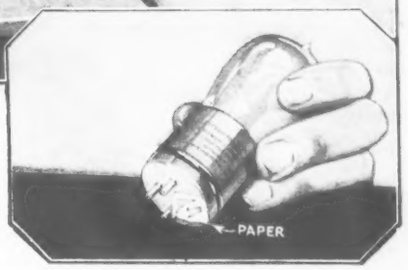


Fig. 3. A piece of paper over one prong of the tube aids in the adjustment

THE chief advantages of Professor Hazeltine's neutrodyne receiver are great amplification of weak signals; a high degree of selectivity; freedom from objectionable squeals and noises; faithful reproduction of broadcast programs; absence of re-radiation (an effect that disturbs neighboring receivers and that is present in most other receivers); and, finally, the unique feature that the several tuning controls are independent of one another and of the filament rheostat settings. This makes it possible to repeat the identical dial settings night after night for any particular station.

The purpose of this article is to describe, for the radio enthusiast who prefers to build his own set, how to construct a standard five-tube neutrodyne receiver, using the standard units. The parts required are as follows (see Fig. 1):

Set of neutrodyne parts, consisting of 3 radio-frequency transformers, with variable air condensers, *A*, *B*, and *C*, and 2 neutralizing condensers, *J* and *K*
1 panel, bakelite or hard rubber, about 26 by 7 by 3/16 in.
1 baseboard, about 25 by 6 by ¾ in. 5 vacuum-tube sockets, *D*, *E*, *F*, *G*, and *H* (the kind that mount directly on the panel are convenient)
2 audio-frequency transformers *L* and *M*
3 4-inch dials
1 6-ohm rheostat, *Q*
1 30-ohm rheostat, *P*
7 binding-posts
1 single-circuit jack, *O*, and 1 double-circuit jack, *N* (see wiring diagram, Fig. 2)
1 fixed condenser, 0.001 mfd., *T*
1 fixed condenser, 0.00025 mfd., with clips for grid leak, *S*
1 fixed condenser, 0.1 mfd. or more, *R*
1 grid-leak resistance, 2 megohms
1 piece of sheet copper for shield, 20 by 5 by 0.010 in. approximately (almost any other kind of sheet metal will do if this is not easily obtainable)
Copper wire for connections
Varnished cambric insulating tubing

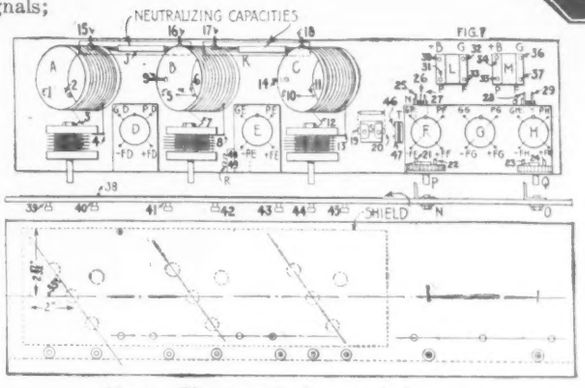


Fig. 1. Diagrammatic layout of the neutrodyne receiver showing position of parts

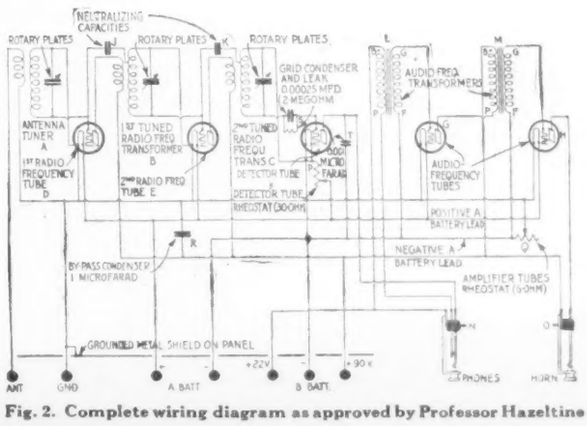


Fig. 2. Complete wiring diagram as approved by Professor Hazeltine

The neutrodyne receiver is not the easiest type for the home worker to build. This fact will, however, probably make the enthusiastic worker more anxious to try his hand at it.

The arrangement and spacings of the various parts are extremely important, so much so that any divergence from the one suggested is likely to give great trouble to the experimenter.

Figure 1 gives the panel layout and a top view of the receiver. The different parts referred to in the list of materials are lettered, and the points where electrical connections are made are numbered or lettered. A good way to proceed in the assembly is as follows:

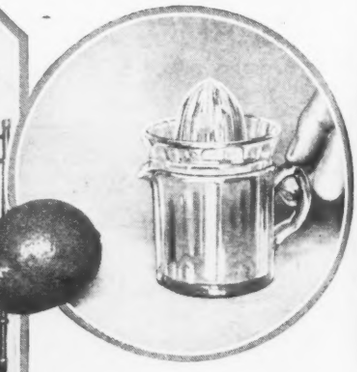
Mark off the panel on the back with a scriber, and drill clearance holes for the shafts of the three

(*Continued on page 146*)

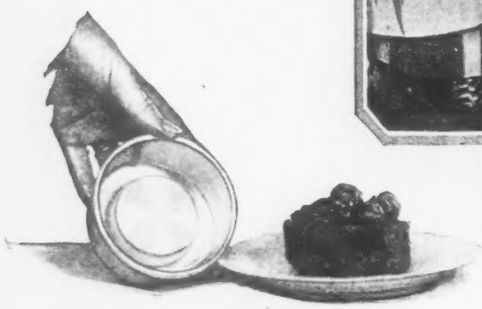
New Tools and Machines Designed

This ingenious four-deck lid is designed to fit pots and pans of practically any diameter within the limits of the largest and smallest flanges of the lid. The four diameters shown above were selected after tests with hundreds of different containers

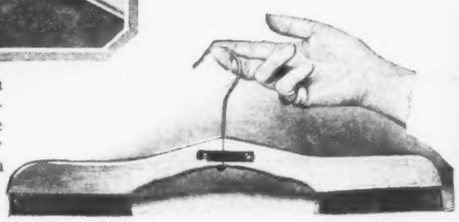
Stove, pantry, ice chest, and kitchen cabinet all are combined in one compact unit in a new type of kitchenette for the small apartment. Every necessity for a meal is within reach



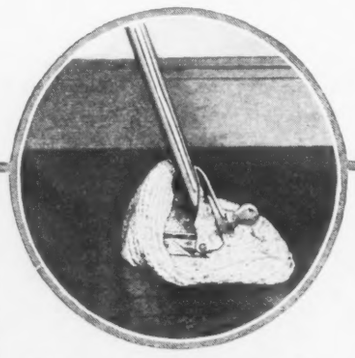
Through holes in the trough of this squeezer, lemon or orange juice drips as fast as it is squeezed from the fruit into the pitcher on which the device rests. The holes are said to prevent the usual wasteful spilling of juice when poured from the ordinary squeezer



This aluminum mold is designed to turn out individual cakes with shallow circular wells indented in the top. Into these wells may be placed ice cream or fresh fruit, as shown

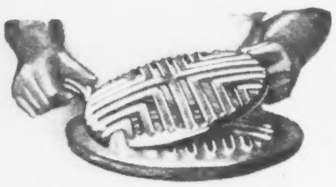


Hinged at the center, this novel coat hanger is folded, when not in use, to form a clothes brush with two rows of bristles. When used as a brush, the wire hook is removed



To take the drudgery out of scrubbing day, and to save the housewife's hands, this mop is equipped with a wringing crank. Three turns of the crank are said to squeeze out the water

Apartment dwellers will appreciate a new disappearing cedar chest that rolls under the bed on tracks, making use of valuable space that otherwise would be wasted



Juices from the meat as it is cooked on the top section of this aluminum broiler are caught in grooves and conveyed to a deep outer depression in the lower griddle

Equipped with extra large, pliable rubber rollers, a new electric wringer cannot injure the fingers nor break buttons, it is claimed. The frame is made of aluminum

for the Housewife's Workrooms

Any cylindrical cooking vessel can be transformed into an electric cooker, it is claimed, when it is encircled by this electric heating band. The band containing heating units is adjustable to fit pots of various sizes

This electric fireless cooker is attached to a light socket and may be regulated to start and stop at any specified time in the housewife's absence. The top is reversible, providing an electric grill for frying, broiling, and toasting. Two heating units direct the heat upon the cooking food from both top and bottom

Poached eggs are molded to shape by this utensil. The eggs are placed in aluminum rings that rest on a flat base. A lever raises the rings

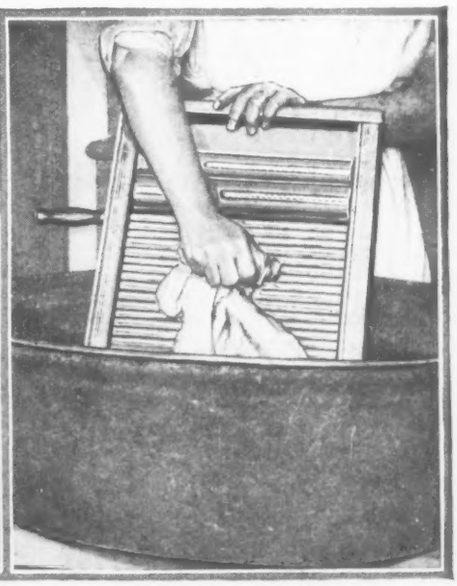
The medicine bottle can be kept free from dust by means of this rubber hood that fits over the top of the cork and eliminates germs

An ordinary plate is converted into a sandwich tray by attaching this handle to the plate rim. Springing the ends apart removes the handle

The task of removing the layers of a baked cake from their pans without breaking them has been simplified by a pan made in two units, as shown above. By removing a metal clamp, the wall of the pan can be separated and lifted easily from the bottom

Here is an electrical household servant that quickly cleans, dries, and polishes glasses. A center buff polishes the inside of the glass, while four outer buffs give the outside a good polish

An opened cream bottle hung in this holder is protected from dogs, cats, rain, or snow. The neck slides into slots at the sides



Wringer and washboard are combined in this handy new aid for washday. Springs controlling the grip of the rollers are said to permit wringing material that is half an inch thick

Your Home Garden—How to Make It Pay

An Expert Tells the Secrets of Scientific Vegetable Planting and Cultivation

By Ernest Bade, Ph.D.

PROBABLY no hobby has more adherents than gardening. Few persons who have a plot of ground available fail to cultivate it, for there is a strange thrill in watching the seeds you have planted grow to maturity, and much pleasurable, healthful exercise to be derived from working the soil. There is an immense amount of satisfaction, too, in producing good crops and supplying fresh vegetables for your table. It is a satisfaction that any amateur gardener can experience if he will use care in selecting his seeds and will follow a few simple principles in cultivating his land.

How to Start Right

If the land you intend to use for your garden has not been under cultivation before, you cannot grow vegetables successfully there until you have destroyed the acid in the soil by sprinkling the ground lightly with lime. This also loosens the earth, permitting you to work it more easily.

Spade up the ground thoroughly, working the lime into the soil. Then add stable manure for fertilizer, mixing this in thoroughly. Be sure that the manure is well-rotted, since fresh manure is useless for fertilizing. Also, do not use such commercial fertilizers as are especially prepared for the peculiar needs of the professional farmer, for they are not suited to the home garden. Stones, of course, should be removed while the bed is being worked. When the ground has been smoothed off with a rake, it is ready for planting. If the land has not been idle for any length of time, the use of lime is not necessary in the preparation of the bed.

Remember that most vegetable plants have their origin in warm countries. Consequently they are not hardy, and they cannot withstand extreme climatic changes. The garden, then, should be located, if possible, in a warm, protected place—one that admits both light and air. Land with a southern exposure makes the ideal location for a garden. Protection for the plants from the wind and cold usually can be obtained by screening the garden with high plants or with fences to break the force of the wind.

Since most amateur gardeners have no large plot at their disposal, intensive cultivation becomes a necessity. All

In planting seeds, a line of stout cord will help keep the rows straight

A Time-Table for Planting Vegetables

STATES AND SECTIONS	SOW OR PLANT OUT		KILLING FROSTS	
	Hardy Vegetables	Tender Vegetables	Spring Average Last	Autumn Average First
Alabama	Feb. and Mar.	Mar. and Apr.	Feb. 24 to Mar. 11	Nov. 8 to 30
Arizona	Jan. and Feb.	Mar. and Apr.	Feb. 18 to Feb. 23	Dec. 7
Arkansas	Mar. and Apr.	Apr. and May	Mar. 1 to 20	Nov. 5 to 10
Calif., Mid. Sou.	Feb. to Apr.	Mar. to Apr.	Mar. 10 to Mar. 17	Dec. 17
Calif., Northern	Mar. and Apr.	Apr. and May	Apr. 2 to 16	Nov. 15 to 25
Colorado	Apr. and May	Late May and June	Apr. 11 to May 15	Oct. 7 to 29
Connecticut	Mid. Apr. and May	Late May	Apr. 15 to May 1	Oct. 17
Delaware	Apr. and May	Mid May	Apr. 10 to 20	Nov. 1
Florida, South	Jan. to Feb.	Late Feb. and Mar.	Feb. 8 to 14	Dec. 29
Florida, North	Feb. and Mar.	Late Mar. and Apr.	Feb. 19 to 23	Dec. 5
Georgia	Feb. and Mar.	Late Mar. and Apr.	Mar. 1 to 24	Nov. 7 to 26
Illinois	Apr. and early May	Mid May to June	Mar. 29 to Apr. 20	Oct. 15 to 28
Indiana	Apr. and early May	Mid May to June	Apr. 10 to 16	Oct. 19 to 30
Iowa	Apr. and early May	Late May	Apr. 10 to May 1	Sept. 23 to Oct. 17
Kansas	Late Mar. and Apr.	Mid May	Apr. 6 to 24	Oct. 14 to 19
Kentucky	Late Mar. and Apr.	May	Apr. 6 to 18	Oct. 19 to 29
Louisiana	Feb. and Mar.	Late Mar. and Apr.	Jan. 24 to Mar. 4	Nov. 11 to Dec. 15
Maine	Early May	Late May and June	May 14 to 28	Oct. 12 to 18
Maryland	Mar. and Apr.	Late Apr. and May	Apr. 4 to 18	Nov. 4
Massachusetts	Late Apr. and May	Mid May to June	Apr. 10 to 26	Oct. 22 to Nov. 5
Mich., South	Mid Apr. and May	Mid May to June	Apr. 30 to May 8	Oct. 10
Mich., North	May	Late May and June	May 10 to 16	Sept. 24 to Oct. 2
Minnesota	May	Late May and June	May 6 to 14	Sept. 22 to Oct. 14
Mississippi	Feb. and Mar.	Late Mar. and Apr.	Mar. 1 to 20	Nov. 2 to 12
Missouri	Late Mar. and Apr.	Late Apr. and May	Apr. 2 to 16	Oct. 13 to 27
Montana	Mid May	June	May 10 to 12	Sept. 18 to 25
Nebraska	Apr. and May	Late May	Apr. 15 to May 9	Sept. 18 to Oct. 12
Nevada	May	June	May 11 to 29	Sept. 24
New Hampshire	May	Late May and June	May 13 to 20	Sept. 16
New Jersey	Apr. and early May	Mid May and June	Apr. 11 to 16	Nov. 4
New Mexico	Mar. and Apr.	Late Apr. and May	Apr. 15	Oct. 19
New York, South	Apr. and early May	Mid May and June	Apr. 10 to 24	Nov. 6
New York, North	May	Late May and June	Apr. 25 to May 1	Oct. 6 to 19
North Carolina	Mar. and Apr.	Late Apr. and May	Feb. 28 to Apr. 5	Nov. 4 to Dec. 11
North Dakota	May	Late May and June	May 15 to 18	Sept. 15
Ohio	Mid Apr. and May	Mid May and June	Apr. 14 to 24	Oct. 15 to 31
Oklahoma	Mar. and Apr.	Mid Apr.	Apr. 2	Oct. 31
Oregon, West	Mar. and Apr.	Late Apr. and May	Apr. 15 to 20	Oct. 30
Oregon, East	May	Late May and June	June 3	Sept. 27
Pennsylvania	Apr. and May	Mid May and June	Apr. 8 to 26	Oct. 19
Rhode Island	Mid Apr. and May	Late May and June	Apr. 18 to May 1	Oct. 16 to Nov. 16
South Carolina	Feb. and Mar.	Apr. and early May	Mar. 1 to 23	Nov. 8 to 30
South Dakota	Late Apr. and May	Late May	Apr. 30 to May 1	Sept. 20 to 30
Tennessee	Mar. and Apr.	May	Mar. 24 to Apr. 3	Oct. 24 to 28
Texas, South	Feb. and Mar.	Mar. and Apr.	Feb. 5 to 27	Nov. 30 to Dec. 25
Texas, North	Mar. and Apr.	Apr. and May	Mar. 20 to Apr. 16	Nov. 1 to 19
Utah	Apr. and May	Late May and June	Apr. 23	Oct. 18
Vermont	May	Late May and June	May 13 to 18	Sept. 16
Virginia	Mar. and Apr.	Late Apr. and May	Mar. 27 to Apr. 23	Nov. 1 to 22
Washington	Mar. and Apr.	May	Mar. 14 to Apr. 6	Oct. 17 to Dec. 15
West Virginia	Apr. and May	Late May	Apr. 11 to May 12	Oct. 4 to 17
Wisconsin	Apr. and May	Late May and June	Apr. 21 to May 5	Oct. 4 to 17
Wyoming	May	June	May 19 to 22	Sept. 11 to 16

Photo and table courtesy Peter Henderson & Co.

THE HARDY VEGETABLES, referred to above, the seeds of which may be sown, or the plants set out very early, even before the last of the frosts are over, are:

Asparagus, Beet, Broccoli, Brussels Sprouts, Cabbage, Carrot, Cauliflower, Celeriac, Celery, Corn Salad, Cress, Endive, Kale, Kohl Rabi, Leek, Lettuce, Onion, Parsley, Parsnip, Peas, Potatoes, Radish, Rhubarb, Salsify, Spinach, Turnip, and Witloof.

THE TENDER VEGETABLES, the seeds of which should not be sown in the open, nor the plants set out until both weather and ground are settled and warm, are:

Beans, Corn, Cucumber, Egg Plant, Melon, Okra, Pepper, Pumpkin, Squash, Sweet Potato, and Tomato.

If you are setting out a backyard vegetable garden this spring, cut out this table and tack it up where you can use it for handy reference.

The Right Way to Grow Seedlings

vailable land must be under ultivation continuously dur- g the gardening season if a aximum yield of crops is xpected. This effect usually s obtained in a small garden y sowing the seeds of plants hat do not come to maturity ntil the fall in beds that lready have yielded a crop f early vegetables.

Intensive Planting

It is quite feasible to sow arly and late vegetables to- ether in the same bed. The arly vegetables develop so apidly that they can be har- ested before the late vege- ables have begun to develop.

The rotation of crops, so ecessary in large farming perations, is even more im- ortant in the small garden. hat is, the same beds must ot be planted for the same rops year after year. Differ- nt plants absorb different lements from the soil in the rocess of growth, and it is irtually impossible to re- lace these elements by fer- lizing. You cannot increase e yield of your garden by lanting thickly. A given rea of ground can produce lants only up to a certain mit, and crowding the plants ill cause them to die.

Owing to climatic differ- nces in various sections of a ountry as large as the nited States, it is impossible o lay down any hard and st rule as to the proper me for starting your garden. ou should wait, of course, ntil you are certain that the ost is out of the ground, and you should elay planting until the soil is well pre- ared. Sowing the seeds a few days late preferable to losing your crop because e seeds have been placed in poorly pre- ared soil. A sandy soil, which heats ore quickly, permitting heat to reach e roots more readily, can be sowed rlier than a clay soil.

Begin planning your garden early in the ar, deciding definitely on the location the various plants and drawing a dia- am of the land you intend to cultivate. his will avoid loss of valuable time hen you are ready to sow.

An Early Start with Hotbeds

Hard seeds will germinate more ickly if they are soaked in warm ater—about 120° F.—for about 12 ours before planting. The planting, owever, should follow immediately e soaking of the seeds.

A hotbed for the cultivation of edlings will enable you to start rtain vegetables as early as Feb- ary or March. If you can obtain a w old windows, you can make an xcellent hotbed by constructing box ames of 12-inch lumber, using the indows as glass covers. These should ce the south or southwest, with one end raised so that the box slants toward the sun at an angle of about 30 degrees. Fill the box to the depth of about a foot with decomposing manure. Moisten, pack down and cover with four or five inches of good soil. Insert a thermometer about two inches in the soil, and, when the temperature has risen and then fallen to 90 degrees (which will be in from five days to two weeks), the hotbed is ready for planting. Hotbeds should be watered and ventilated every day and their glass coverings should be raised to prevent the intense heat that is produced in them on fair days from harming the plants. Plants started in a hotbed, of course, must be transplanted to the garden later in the season.

Regarding the intensive cultivation mentioned before, the first crop from your garden should consist of early vegetables, such as beets, spinach, radishes, and lettuce. After these have been harvested, say in May or June, the ground from which they have been taken may be replanted with late vegetables, after it has been thoroughly worked and fertilized. Early and late vegetables also may be planted together fairly early in the season, the late varieties being planted between the early rows.

Watch and Weed

After watering your garden and after every rain, see that the soil does not crust over and crack open. If this occurs, the whole garden should be thoroughly hoed to loosen the soil. This will also give a splendid opportunity to remove weeds. Weeding, of course, should be performed regularly, since weeds are intruders and robbers that steal from the soil the nourishment your plants require.

Little hills or mounds of soil made with the hoe about the lower stems of such plants as beans, peas, potatoes, cucumbers, tomatoes, pumpkins, cabbages, Brussels sprouts and celery, will protect the plants from too rapid evaporation of the soil moisture, and will prevent the cold water from hose or watering can from injuring the roots. In addition, a large number of roots will form in these mounds, anchoring the plant firmly in the soil and making it almost impossible for a strong wind to uproot them. Such hills in a row also form the sides of shallow troughs that prevent the water from running off the bed.

The tools required for a small garden include a spade, a hoe, a rake, a hand weeder, and a length of stout cord to guide you in placing your rows in orderly, straight lines. With these, a little interest, and intelligent care, the most inexperienced gardener will achieve astonishing results.

Place flat stones in the seed box for good drainage

Fill the box with layers of manure and rich soil

Plant the seeds in shallow rills running in parallel lines across the box

After the seeds are planted, fill the rills with soil, covering the seeds

A box of vegetable seedlings ready to be transplanted in the garden

Photos Courtesy Peter Henderson & Co.

After the soil has been worked, rake the bed smooth, removing all rocks and pebbles

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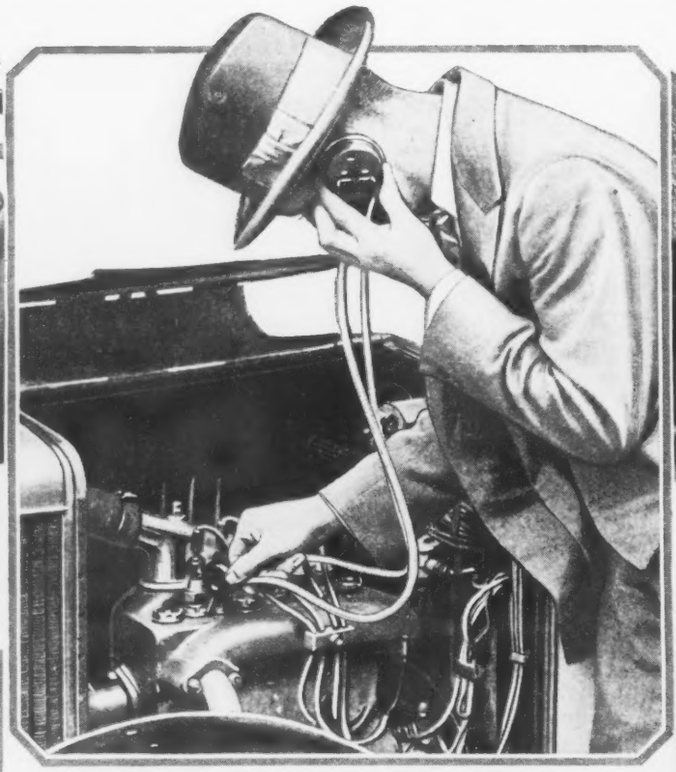
IT WOULD save trouble and expense, wouldn't it, if coal could be piped from the mines direct to your furnace, just as electricity and gas now are delivered from central stations? Read, in next month's issue, about the recent successful experiments with "black flour," the world's newest fuel.

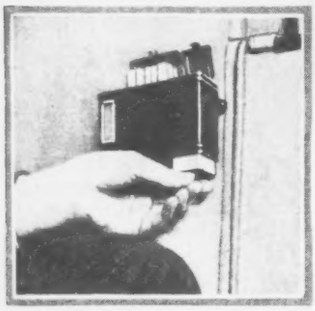
New Additions to Car Enjoyment

One of the new devices to shield the driver's eyes from oncoming headlights is a semi-transparent plate attached to the windshield. While baffling glaring rays, it does not obstruct vision

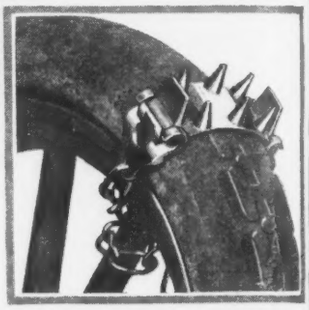


Identifying a troublesome spark plug has been made easy, it is claimed, with this phone detector. The tips of the wires are touched to the plug. The strength of the sound then indicates the strength of the spark

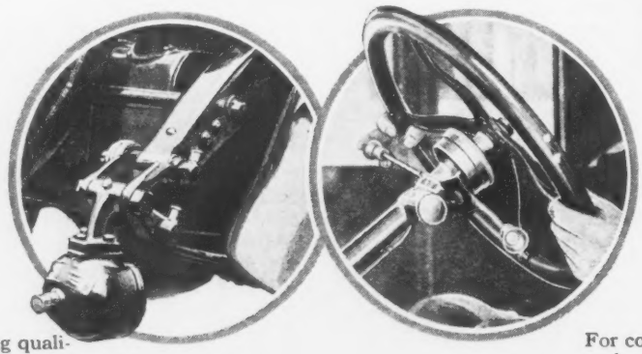
Unusual resiliency, shock-absorption, and increased tire mileage are claimed for this new type of spring wheel. The hubs are flexibly suspended, giving a sort of floating wheel action



Smoking convenience while driving is provided by the three compartments of this compact cigarette case. One compartment holds cigarettes that protrude when the lid is raised. The other compartments are used for the matches and ashes

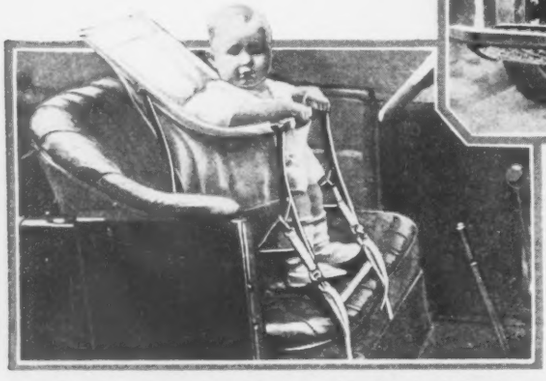


The car that is stuck fast in a mud hole can climb out under its own power, it is claimed, with the aid of this emergency mud shoe. It holds six spikes bordered by two chisel-like ridges

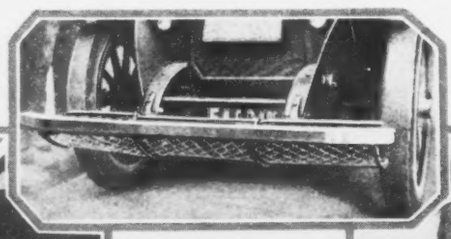


Depending on the cushioning qualities of an inflated rubber ball, the new shock absorber shown at the upper right replaces the spring shackles. The ball is inflated like a tire

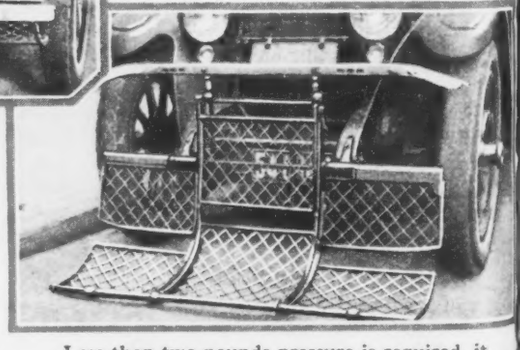
For convenient manipulation of gas and spark levers, small rubber knobs have been designed to slip over the ends of the levers, providing a quick, easy hold for the fingers



A safe and comfortable auto ride for the baby is the purpose of this folding canvas chair, attached to the front or back seat of the car with straps



Combining neat appearance with effective action, a new safety bumper remains inconspicuously collapsed, as shown above, until it strikes an object or until released by the driver. Then it drops to the position shown at right



Less than two pounds pressure is required, it is claimed, to release the safety fender, which is said to open at the instant of impact

Are YOUR Headlights Dangerous?

How to Stop the Blinding Glare that Invites Disaster at Night

By F. A. Platte

Instructor, Department of Physics, Columbia University

If your headlights cast a blinding glare into the eyes of the other fellow on the road, you are inviting disaster not only to him but to yourself. The pointers below will help to insure you against this danger

CRASH! I stopped my car, and peered back into the night. Two cars were locked together in the middle of the road. I put my motor in reverse and backed up to them, believing I should have to carry some one to the hospital; but I was relieved to find that damage had been done only to the cars. Each driver was blaming the other for the accident, and it was some time before I learned what actually had happened.

Dazzled by the other's glaring headlights, one driver had been unable to see the road before him, and had headed his car directly into the other.

Who was to blame? There could be only one answer. It was the driver who, through ignorance, carelessness, or selfishness, had operated the car with glaring headlights.

Bright Headlights Confuse Drivers

Every motorist has experienced the inconvenience and worry of night driving caused by approaching cars with headlights that throw blinding beams into his eyes. If the glare is especially bright, a driver virtually loses his sense of direction, and, if inexperienced, is likely to swerve his car unconsciously and to meet disaster. In fact, even an experienced motorist cannot feel absolute security against the menace of the glaring headlights of other cars.

Glaring headlights are unnecessary, and they are almost as dangerous to the car that carries them as to the cars that may be passed, for, when your headlights dazzle another motorist, it is more than likely that it will be *your* car he will hit. So for your own safety you should make sure your headlights are properly adjusted.

Inspect and Adjust

Periodic inspection and adjustment of the headlights are essential to the elimination of glare. These operations are simple and require little time. Two things are to be considered—the proper location of the lamp in its socket and the angle at which the light beam leaves the lens.

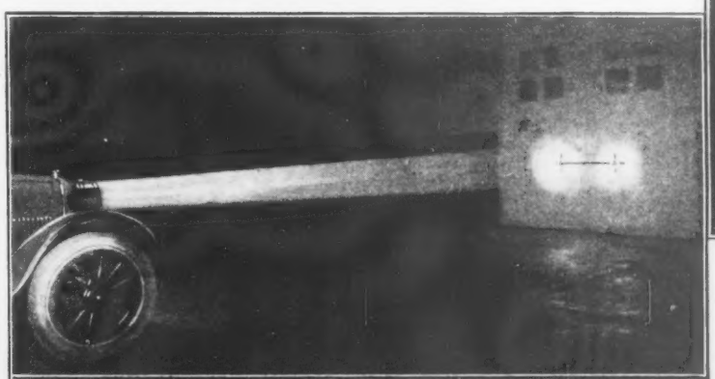
1. Be sure each lamp is in focus.
2. See that each light beam is directed so that the top of the beam is at the level of the lamp.
3. Equip the lamps with anti-glare lenses.
4. Be sure the lenses are right side up.
5. Use lamp bulbs of not more than 21 candlepower.
6. Examine and test your headlights frequently, according to directions on these pages

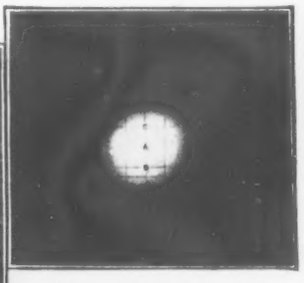
To determine whether the lamps are properly focused, drive the car, fully loaded, toward a wall or other flat, vertical surface and stop about 75 feet away. A shorter distance will serve, but it should not be less than 25 feet.

To Test Lights

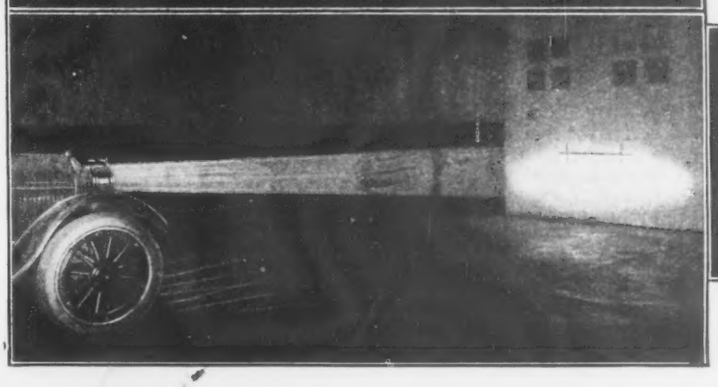
Now remove the lenses. Cover one lamp and note the shape and size of the reflection that the other casts on the wall. Turn the screw or other adjusting device with which your lamp is equipped until you have produced the smallest and clearest possible reflection on the wall. This reflection, to be most efficient, should be circular in shape.

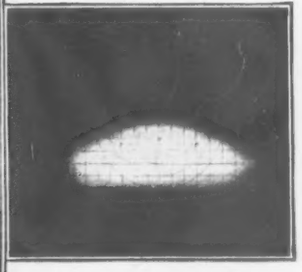
That lamp now is in proper focus. By turning the adjusting screw, you have moved the lamp backward or forward until it has reached the particular point in relation to its reflector that is called the focus. When the lamp is in this position, all rays of light emerge from it in parallel lines. When the lamp bulb is in front of the focus, the rays cross; when in rear, the rays diverge. In either case in which



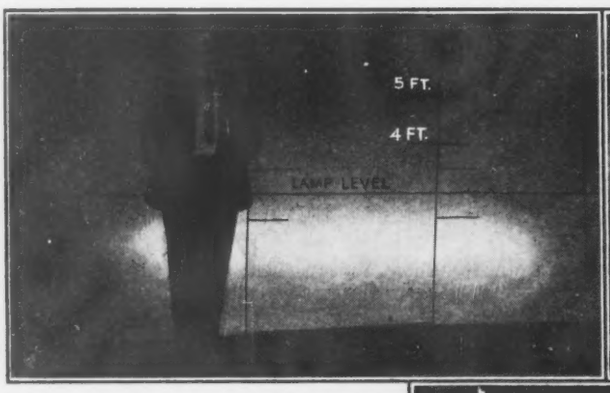


Above: Reflection of a correctly focused headlight with lens removed. At the left: Round reflections from both lamps, when correctly focused

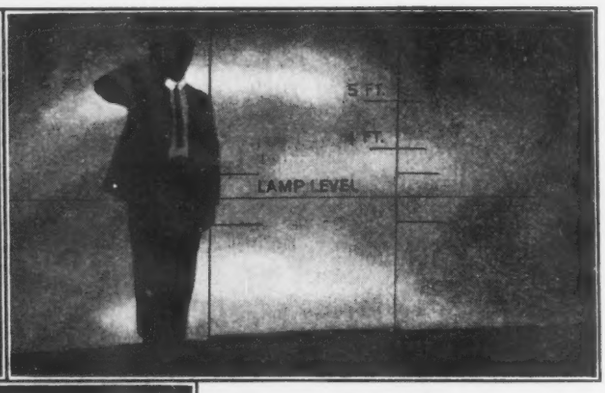




Above: Oval reflection, correct focus, with lens in place. At the left: Correct combined reflections



Correct headlight reflection at a distance of 25 feet, produced when lamp bulbs are at focus, as in Fig. 1 at the right. The top of the reflection is at automobile lamp level



Dangerous headlight reflection, at a distance of 25 feet, produced when lamps are out of focus, as in Figs. 2, 3, and 4, below. The rays that mount above lamp level are dangerous

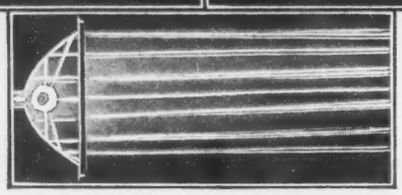


Fig. 1. Lamp bulb at ocus; rays parallel

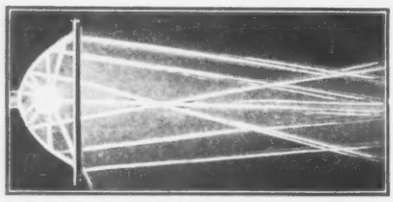


Fig. 2. Ahead of focus; rays converge

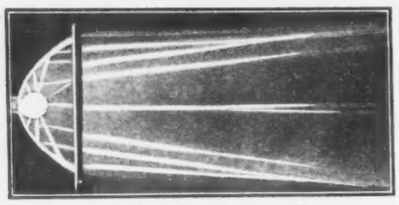


Fig. 4. Behind focus; rays diverge

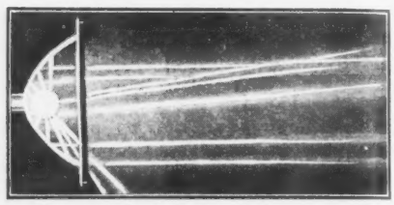


Fig. 3. Below reflector; rays scattered

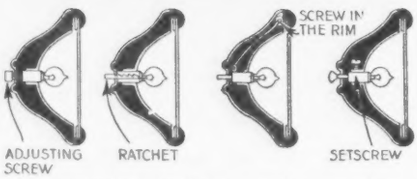
the lamp is out of focus, the reflection on the wall will be a large ring and not a small, solid round spot. The rays that compose the upper portion of this large ring are the dangerous ones that are projected into the eyes of approaching motorists. Adjust the second lamp in the same way.

Having completed these adjustments, replace the lenses on the lamps, making sure that they are right side up. Immediately the reflections on the wall become oval in shape. The reflections of lamps should combine to produce a flat oval reflection. When this is obtained, the lights should be adjusted for height of beam. The top of the beam should be at the level of the lamps, or at about the height of the waistline of a grown person. With a light car this level should be even lower, for when several heavy people enter the car, their weight tilts the front end.

Correct Headlight Angle

Most cars are provided with an adjusting device to tilt the headlights. If your car is not provided with an appliance of this sort, you must bend the lamp brackets until the proper beam level is obtained. If when you sit in your car, you can see with reasonable clearness the head or neck of a person standing from 25 to 75 feet away, the beam cast by your lights is too high. Either the focus must be changed, or the lamp must be tilted down.

In addition to the two all-important considerations mentioned above, the lights can be improved further by using anti-glare lenses and polishing the reflectors with a soft cloth dipped in powdered lampblack. The various makes of special anti-glare lenses are of two kinds —diffusing and deflecting. Diffusing lenses resemble ground glass and scatter the beam. Deflecting lenses merely take those beams that project upward and bend them down so that none will rise above the lamp level. Although most of these devices will accomplish the desired purpose, there are some which bend the rays down so much that they strike the road just in front of the car. While this eliminates glare, it also eliminates a good view of the road.



Four standard headlights, showing controls by which lamp bulb is adjusted to focus

Another important consideration is that the lamps be of proper candlepower. Too intense a light from the lamp will produce too sharp a beam. Even though this may not shine directly into the eyes of an approaching motorist, it may be strong enough to cause him annoyance.

If you follow these precautions, you will find you have an ideal light preceding your car—one that will illuminate objects sufficiently; one that will throw its brightest rays on your side of the road; and sufficiently close to the car to see the road ahead; one that will permit you to view the full width of the road for at least 200 feet, but without casting a dangerous light into the eyes of other drivers.

Furthermore, you will be spared the annoyance of continually turning on and off your lights, a dangerous practice in itself.

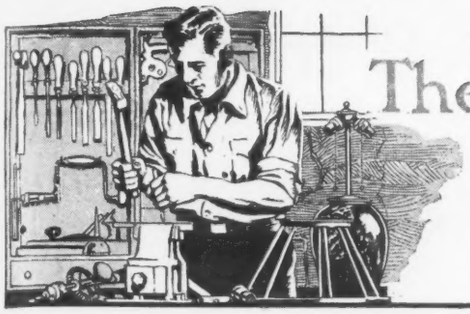
IN ANOTHER useful article next month, Mr. Platte will tell how you can get more miles to a gallon of gasoline.

Know Your Car

The Valve Inside.—This small, but important piece of mechanism, consisting of a plunger faced on one end with a rubber plug and surrounded at the bottom by a small spring, plays a vital part in the life of your automobile tire. Inclosed within the tire valve stem, it is the mechanism that opens to permit the entrance of air during inflation, and automatically closes to hold the air within the tire tube during service. In large pneumatic tires it is called upon to hold back a pressure of more than 100 pounds, a pressure that increases with severe road jars.

During inflation, air pressure from the pump forces the plunger inward against the spring. As soon as this pressure is released, the spring forces the plunger back into position, where the rubber plug acts as a washer to prevent escape of air from the tire.

The valve cap always should be screwed firmly over the valve stem to keep out dirt and to provide a secondary seal against escape of air.



The Home Workshop

Arthur Wakeling, Editor

Chinese Game Table Has Every Playing Aid

COLORFUL, picturesque, and fascinating as is the ancient Chinese game that has become, under its many aliases, one of the leading indoor pastimes of the country, it is doubly enjoyable when played at a properly equipped table.

Many costly sets are being used on rickety card tables with loose tile racks that do neither the game nor the set full justice. The table should be especially built for the game, with convenient racks and counter holders and a felt-covered playing surface for building the wall of tiles; and it should have a finish and style to match the workmanship and appearance of the Chinese pieces and beautiful cabinets in which they are stored. Such tables can be purchased for prices ranging from $25 to $75 or more. The cost of making them, however, is very much less, especially as expensive hard woods need not be used.

The table illustrated, which was designed by George F. Kaercher, of Philadelphia, a furniture factory superintendent, combines all the qualities desirable for comfort and convenience in playing the game and at the same time has the appearance of fine workmanship and finish sometimes lacking in even expensive commercial tables.

Fig. 1. The shop details of this attractive piece are contained in POPULAR SCIENCE MONTHLY'S Blueprint No. 32

While the table shown in the central illustration (Fig. 1), will fold up and can be stored away in a relatively small space, it is of substantial construction throughout. Non-folding variations of the same design are equally practical, in which case legs of any of the three types shown in Fig. 2 are alternatives for the plainer legs illustrated in Fig. 1.

The racks for the tiles are fastened to the rim of the table. The counter holders are semicircular troughs or bins that run around the edge. Ashtrays are also provided for the convenience of those who like to smoke while playing.

The top is 3 ft. square, the overall height is 2 ft. 8⅜ in. The legs, like all the other parts, unless otherwise noted below, are maple, oak, or poplar. They are 1¾ in. square and two of them are 2 ft. 6⅝ in. long, the other two being 2 ft. 4⅞ in. The corners of the legs are relieved by being beaded, as shown in Fig. 2, but other styles have the square legs with the edges only slightly rounded or plain tapered legs.

The two longer legs are connected by a rail ⅞ by 6½ in. by 2 ft. 7 in., to which each is fastened with three ⅜-in. dowels. The two shorter legs are similarly fastened to a rail ⅞ by 4¼ in. by 2 ft. 7 in.

The foundation of the table top is a base made of four pieces of whitewood ½ by 3¼ in. by 2 ft. 11⅛ in., mitered and doweled together to form a frame. To one flat under surface of this frame is hinged the pair of longer legs with 1¾ by 2½ in. hinges. To the rail that connects the other two legs is screwed a hinged filling piece ½ by 1½ in. by 2 ft. 7 in. Two hinges are fastened to this filling piece and also to a heavy block 1¾ by 3¾ in. by 2 ft. 10½ in. This block, which lies flat against the under side of the table frame, is notched out, as shown in Fig. 3, to permit the ends of the legs on the other side to enter it when they are folded.

The rim of the table is made of four pieces 7/16 by 4 in. by 3 ft., mitered and doweled. The top and bottom outside edges of these pieces are beaded to give a finish corresponding to the legs.

The racks, which are fastened to the rim, as shown in Figs. 1 and 2, are shaped from pieces 1 5/16 by 1 5/16 by 17 in., with ends cut from pieces 5/16 by

(*Continued on page 118*)

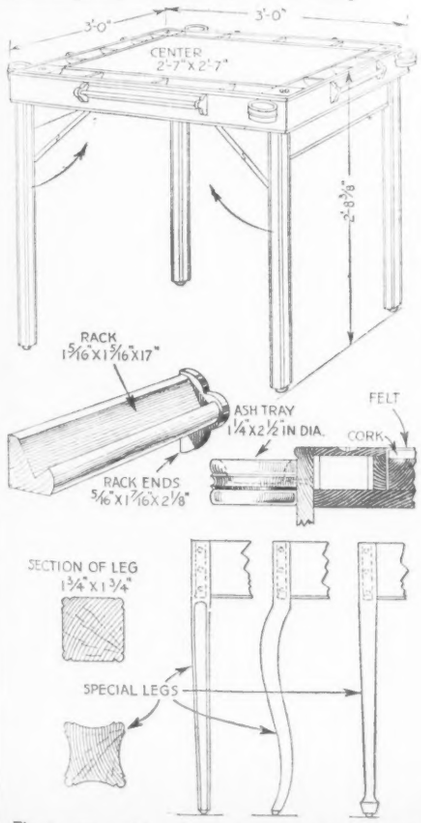


Fig. 2. The table, three alternative leg designs, and details of racks, corner bins, and ashtrays

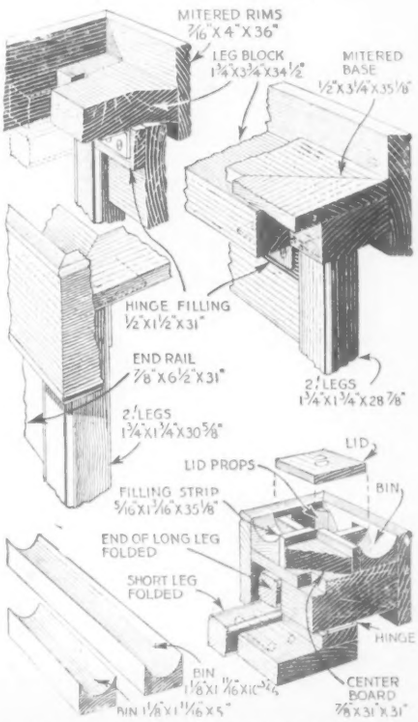
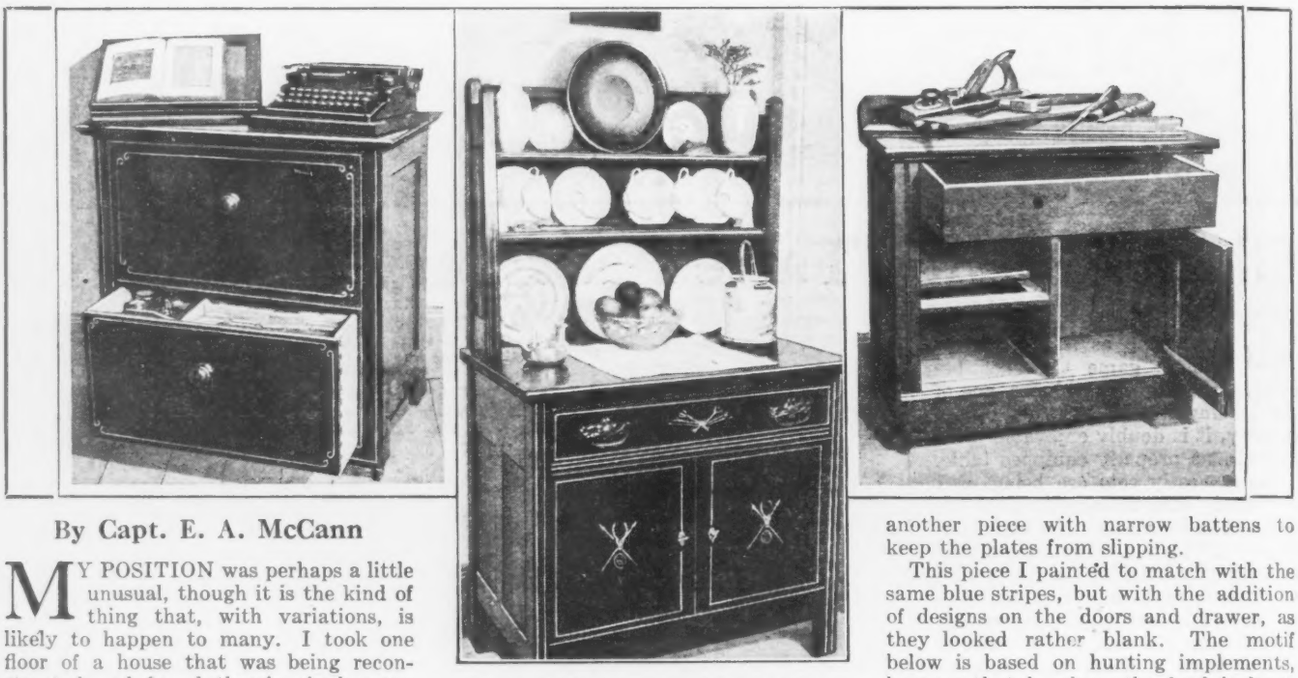


Fig. 3. The corner construction with legs open is shown at top, and with legs folded, below

New Furniture Salvaged from Old



Above, at left: A rebuilt stationery cabinet. Center: A dresser and (at right) the dilapidated commode from which it was built

By Capt. E. A. McCann

MY POSITION was perhaps a little unusual, though it is the kind of thing that, with variations, is likely to happen to many. I took one floor of a house that was being reconstructed and found therein six bureaus and commodes, all very dilapidated and apparently only fit for kindling-wood. They were, however, made of good oak, and it struck me that they might be converted to my uses, thus saving the buying of new furniture, which would most likely not be so suitable and certainly would not have the same interest for me.

Two of the chests of drawers I cleaned thoroughly with lye and carbolic, sandpapered, tightened up the screws a bit and enamelled to go with the color scheme of the room. As this room had not too much light, I papered the walls a corn color, used bright blue curtains and cushions, and enamelled the furniture a rich, tawny yellow, with a pale blue stripe.

One of the bureaus was a small sawed-off highboy. In this I left the lower batten and drawer-slide and shifted the middle one halfway between. Then, from the old drawers, with the addition of some spare wood, I made two drawers and partitioned them so that one side of each would take letter folders.

The balance of the space in the top one was left for a card index, envelopes, notebooks, and the like, and in the bottom drawer I put a slide halfway up to take ink and other bottles, rubbers, and writing materials, with room below for compasses, and other drawing equipment. I put easy running casters on this and now have a handy cabinet for my writing material, which I can either work on or, better, draw up to the table. This saves me a lot of walking about.

The bookrack on top is made from a piece of packing case with a nice grain, stained green. It is just two frames about 14 by 10 in. hinged together in front, with hinged legs on either side and a narrow ledge in front.

One of the commodes I made into the little Welsh dresser shown by fitting a new door on the left and raising the back with shelves. I used the posts and panels at the sides of the shelves to carry out the same pattern as the sides below. The back I panelled quite flat with $\frac{3}{8}$-in. whitewood. The shelves are of oak from another piece with narrow battens to keep the plates from slipping.

This piece I painted to match with the same blue stripes, but with the addition of designs on the doors and drawer, as they looked rather blank. The motif below is based on hunting implements, because that is where the food is kept, but on the drawer it is weapons, as a warning, because the "near" silver reposes there. With blue and white china, ranging from 10 cents a piece to valuable Chelsea and Chinese, it looks fine.

I kept all the furniture short, as the ceiling is not very high. One must always think of these things when furnishing.

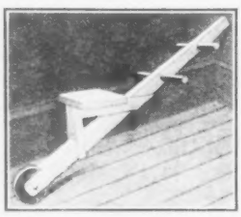
The handles all through are just cheap pierced brass, but I enamelled them blue and then rubbed off the high lights with a cloth pad so that they have the polychrome effect.

Thus it will be seen that with some ingenuity and the aid of simple tools and paint or, if you prefer, stain and varnish, many apparently worthless pieces of furniture can be made into something quite handsome, that will be much nicer, at any rate to you, than what you buy ready made, and the saving is considerable.

Incidentally, in the basements of most apartment houses and many homes may be found quantities of dilapidated furniture that may be had for a smile, perhaps aided in some cases by a small tip.

Boys Enjoy Speedy Coasting with Roller-Skate Scooter

By Dale R. Van Horn



Built from wood picked up from the scrap pile, this unique scooter adds immensely to the sport of roller skating

FUN in roller skating on smooth pavements is doubled with this light, speedy, one-wheel scooter. Carrying it, the skater speeds along as fast as he can go. Then he swings the scooter between his legs, sits down on the seat, and, with the knee rest upon his knees, coasts as far as the momentum will carry him.

The materials can, for the most part, be salvaged from the scrap pile. The hardwood wheel is 4 in. in diameter and 1 in. thick. It will have to be turned in a lathe, cut with a keyhole saw, or shaped with a chisel after the stock has been mounted on any revolving spindle. The main bar should also be of hard wood, although this is not absolutely necessary, and the joints should be screwed.

The accompanying illustration shows how the parts are assembled, and how each is shaped. When painted in bright colors and carefully finished, this device will insure any boy many hours of happy outdoor sport.

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How to Construct a Modern Built-In Buffet

By Edwin M. Love

MANY recently constructed houses have built-in buffets, dining alcoves, bookcases, and the like, but the majority of small dwellings have none of these conveniences. Perhaps nothing in woodworking brings greater satisfaction to the home mechanic than the building of features of this kind, which are well within the ability of any man who can make good joints in wood.

The buffet illustrated is a recent design that has proved popular in new houses. As it stands out in the room rather than in a recess, it can be built into an old house as easily as in a new.

The construction is relatively simple. No elaborate cabinet work is necessary; in fact, all the joints are nailed except those in the doors, and the doors usually can be obtained quite reasonably at a sash and door mill. Wood to match the trim of the room should be used if the buffet is to be varnished, or pine or any easily obtainable soft wood, if it is to be enameled.

Once the method of building the buffet is understood, it is easy to modify the proportions and design to suit any given room. The one illustrated is in a large dining-room and its proportions are generous. The top or countershelf is 2 ft. by 6 ft. 8 in.; the height of the buffet proper is 3 ft., and the mirror back extends 1 ft. 6 in. more, making the total height 4 ft. 6 in.

The mirror is the most expensive item, in this case costing $18. The lumber cost $14.50, the doors $7, and the hardware $2.20. The building time was 30 hours.

Draw on the floor the outline of the frame of the buffet, making the length 6 ft. 6 in., the width 20 in. at the ends and 23 in. at the partitions. The partition lines are spaced 1 ft. 6 in. from each end and like the end lines are squared out from the wall. Nail cleats on the floor ¾ in. inside of each end line, and ⅜ in. to the side of each partition line, and plumb up lines on the wall from these.

Glue up the counter shelf, ends, and partitions, using corrugated joint fasteners every 12 in. on the under side. While the glue is drying, nail on the wall cleats. Measure up from the floor 2 ft. 11 in., and level across. Nail a 1 in. by 3 in. cleat to the wall with eightpenny nails, being careful that the ends do not project beyond the end plumb lines. Lay off the following distances from the top of this cleat downward: 4 in., 4 in., 2½ in., 4 in., 2½ in., 5¼ in., 2½ in., 5¼ in. Rough 2½-in. cleats are leveled across from these points to support the rear ends of the drawer slides, as shown in the perspective illustration of the frame.

When the glued-up stock is dry enough, surface the end pieces and partitions and scribe them to the wall, being sure to keep the front edges plumb. Nail to the floor cleats and tack a brace across the tops to keep the pieces in position.

The 4 hanging stiles are next cut to length, the corner stiles mitered to the ends, and the drawer stiles shaped to the proper angles by planing a bevel on one half of the width only. The thinner edges are placed on the drawer side.

Cut the rails between the stiles, getting the positions by leveling across from the tops of the cleats. Toenail the joints with 4 sixpenny finishing nails, as shown, and nail in the muntin.

The drawer slides, made of 1 in. by 3 in. stock, are placed in the center of the drawer openings, the upper edges projecting above the rails ½ in. Two narrow strips are cut between the upper rail and cleat to prevent the upper drawers from sagging when opened. At the back end of each slide nail a block to the wall as a drawer bumper so as to prevent strain on the edges of the drawer fronts.

Nail 1 by 1½ in. shelf cleats to the ends and partitions, placing the lower cleats so that the shelves will project ½ in. above the bottom rails to form door stops. The upper shelves should be 1 ft. 6 in. above the lower. Counter-shelf cleats are put in as indicated.

Surface the counter shelf, flatten the under side where it bears against the cleats, cut to a length of 6 ft. 8 in., and scribe to the wall. Nail securely to the cleats, and then cut and dress the front edge, allowing a projection of 1 in. beyond the stiles and rails. In putting on the wainscot cap edging, allow a ¼-in. margin on shelf. Make all the angle joints accurately and glue as well as nail them securely. Fit the 2-in. cove underneath: then fit the base and shoe.

The mirror frame is mitered. Except at the top, where 3-in. stock is used, the frame is 1 by 1½ in. Before installing the mirror, paint the molding, as the back edge will be reflected in the glass.

In hanging the doors, be careful to allow about 1/16 in. all around for clearance if the buffet is to be painted. If it is to be varnished, the clearance may be a little less.

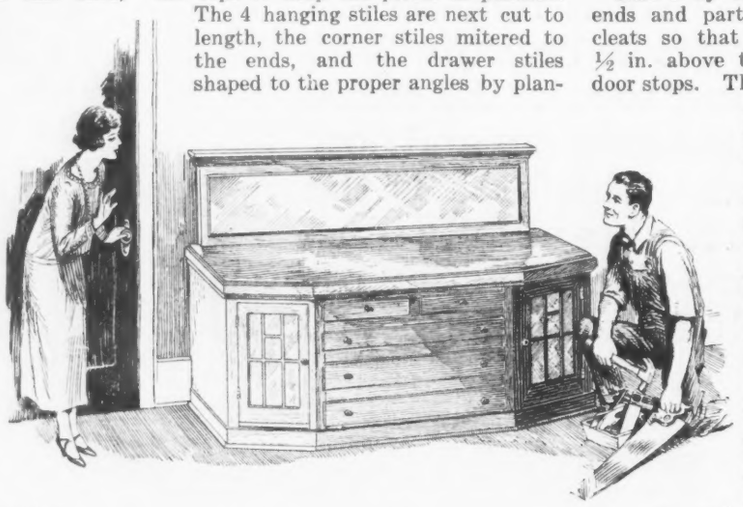
All the woodwork should be carefully scraped and sanded before finishing in either varnish or enamel, as the least rough spot, plane mark, or open joint will show.

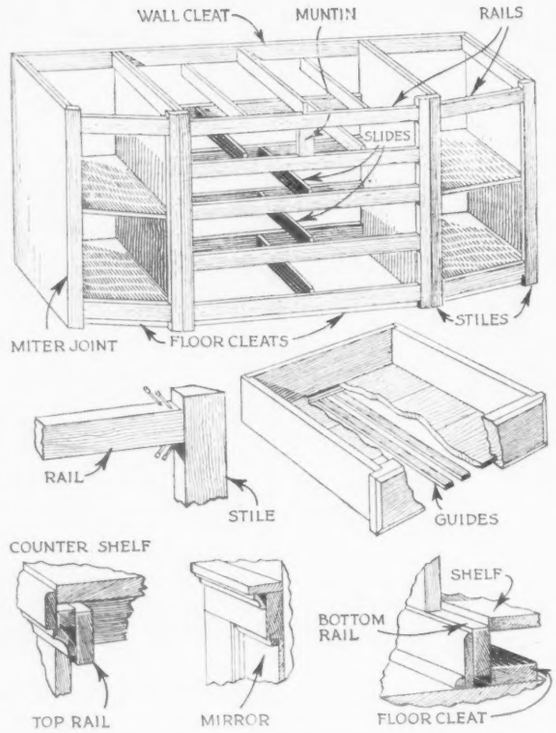
Hardware, other than the hinges used for hanging the doors, should not be put on until the finishing is complete.

The bill of materials follows:

3 pc. 1¼ by 2½ in., net, by 16 ft., "s4s" (surfaced on all four sides.)
1 pc. 1⅛ by 1⅛ in. by 12 ft., "s4s"
1 pc. 1 by 3 in. by 14 ft., "s4s"
2 pc. 1 by 1½ in. by 12 ft., "s4s"
3 pc. 1 by 12 in. by 12 ft., "s4s," for shelves and ends
1 pc. 1 by 12 in. by 14 ft., "s4s," for counter shelf
1 pc. 1 by 6 in. by 14 ft., "s4s," for drawer front
2 pc. ⅝ by 6 in. by 10 ft., "s4s," for drawer sides and backs
24 sq. ft. of ⅜-in. drawer bottom
1 pc. ⅜ by 16 ft. quarter round, mirror molding
1 pc. 1½ by 8 ft. cove, for mirror shelf
1 pc. 2 by 12 ft. cove, for counter shelf
1 pc. ⅜ by ¾ in. by 12 ft., base shoe
1 pc. ⅝ by 2½ net by 12 ft. wainscot cap
1 pc. ⅝ by 4 in. by 12 ft. baseboard
1 pc. 1 by 6 in. by 18 ft., sheathing to be ripped down center for floor and wall cleats, drawer slides, etc.
2 sash doors to fit openings
2 pair 2½ by 2½ in. loose pin butts, dull brass
50 corrugated ⅝-in. steel fasteners (clamp nails)
10 drawer knobs for drawers and doors
2 forge catches
1 12 by 75 in. plate mirror

In ordering, it should be remembered that surfacing of finished stock reduces the actual dimensions ¼ in. to ¾ in. below sizes ordered, unless marked "net."





The completed buffet, the general construction of the frame, and details of drawers, countershelf edging, mirror cap, base molding, and method of nailing together rails and stiles

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"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

Better Shop Methods

How Expert Mechanics Save Time and Labor

Speedy and Accurate Ways of Boring

By George Arthur Luers

Mechanical and Automotive Engineer

"ERROR in machining. Score in finished bore of cylinder casting. Mechanic Joseph Dyson. Hired Feb. 20, 1922. Reported for inspection and action."

This report was the signal for the dismissal of mechanic Dyson. He had not studied the methods of finish boring very carefully and as a result had used too little lubricant. This ruined the casting and he lost his job.

While most mechanics know something about tools for enlarging and finishing cylindrical openings and realize that various kinds of boring tools are available, there are few who have studied boring operations sufficiently in relation to speed and accuracy. Many machine hands are lost when it comes to finish boring holes of large diameter or in work of unusual character.

Before starting a boring job, the mechanic should analyze the situation and decide on the type of tool that will give the best results. He must then see that all the cutting edges are in good condition. A proper holder must be selected so that the tool won't slip and gouge the work. Lastly, he must make sure that the proper kind of lubricant is fed to the cutting edge in sufficient quantities to insure best results.

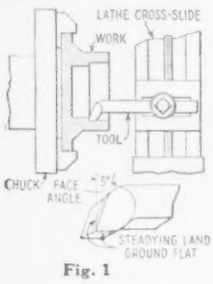
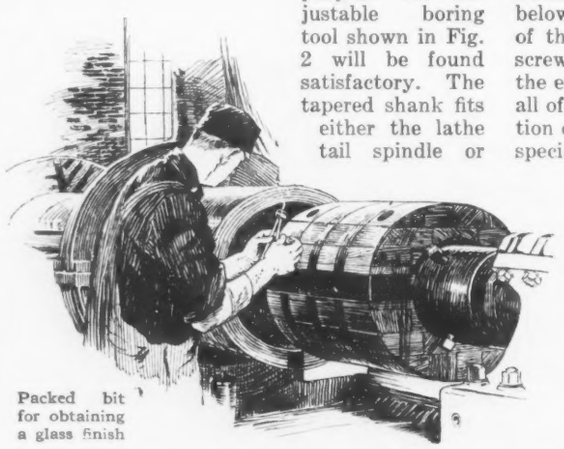


Fig. 1

A dependable practice for lathe boring is a fixed cutter in the toolpost of the cross-slide. It must be sufficiently long, as shown in Fig. 1, to make the complete bore without shifting the tool. The angular shaped nose of the tool and the steadying land below the cutting edge permit rapid cutting and still produce a smoothly machined surface. With tools of this shape there will be no excess chatter, and scale riding will be eliminated.

Instead of holding the tool rigidly in a toolpost, it may be necessary to have it so that it can be easily adjusted. For this purpose the adjustable boring tool shown in Fig. 2 will be found satisfactory. The tapered shank fits either the lathe tail spindle or the spindle of a vertical or horizontal boring machine. A single tool is fastened in the swivel by means of setscrews, and two adjusting screws permit adjustment of the cutting edge within a limited range. This type serves as a good all-purpose tool and the method of support provides the requisite steadiness to prevent chatter.



Packed bit for obtaining a glass finish

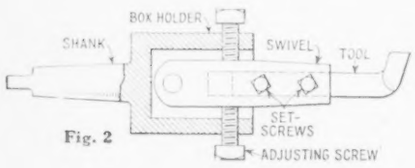


Fig. 2

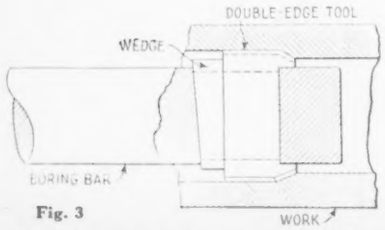


Fig. 3

Typical lathe boring tool, adjustable boring tool, and a simple double-edged cutter

Using a Double-Edged Cutter

Where holes are deep, it is best not to attempt any boring with a single tool in a long boring bar since excess chatter is sure to result. For this purpose, a double-edged cutter will be found more satisfactory. Figure 3 shows a simple type. The tools should be set at equal distances from the center of the bar in order that the opposite cuts will have equal resistances. In this way great smoothness can be obtained.

While the long bar usually is used in a drilled hole, it will give good results even in a pipe having hard scale. Since the cutting edges are balanced, there will be no tendency to ride the scale. For this reason the edges can be ground to the usual taper of a drilling bit. The tool may be made of one or more pieces, but it must be possible to move out the tool as wear occurs. The wedge method of holding the tool in a rectangular slot is both simple and dependable, for it holds the tool firmly and allows for easy adjustment and removal of the tool for grinding.

Having decided upon either a single- or double-edged cutter, the mechanic's next consideration should be the holder. Figure 4 shows four methods in addition to the wedge method just mentioned that are considered satisfactory in making boring-tool holders.

Where additional support is needed, the upper two holders can be used to advantage. Here the tool is away from the end of the bar and the end can bear in a jig or bushing guide. The screw method shown below is applicable to cutters at the end of the boring bar, while the wedge and screw conjointly are used when finishing the extreme end of a bored recess. While all of these methods are correct, the selection of any one of them depends upon the special job that is to be done.

In all holding methods the wedges should have very slight tapers and the screws should be sufficiently large so that there will be no loosening or shifting under the cutting strain. Just a slight shift may produce an ineradicable gouge.

One of the hardest problems of the mechanic is the construction of a suitable tool for recess boring. To be successful, it must be made so that the tool can be expanded and also contracted for withdrawal. Wedges will serve to open the tool, but they will not facilitate the closing, with the result that the tool protrudes as it is withdrawn and a gouge is made in the work.

Figure 5 shows a tool that has worked satisfactorily in recess boring. A central

(Continued on page 108)

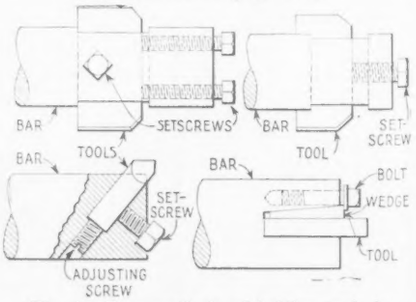


Fig. 4. Four methods of holding tools in boring bars, each having special advantages

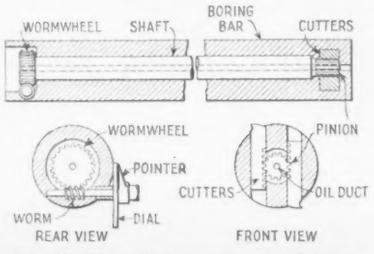


Fig. 5. One of the most successful types of adjustable boring bars for recessed work

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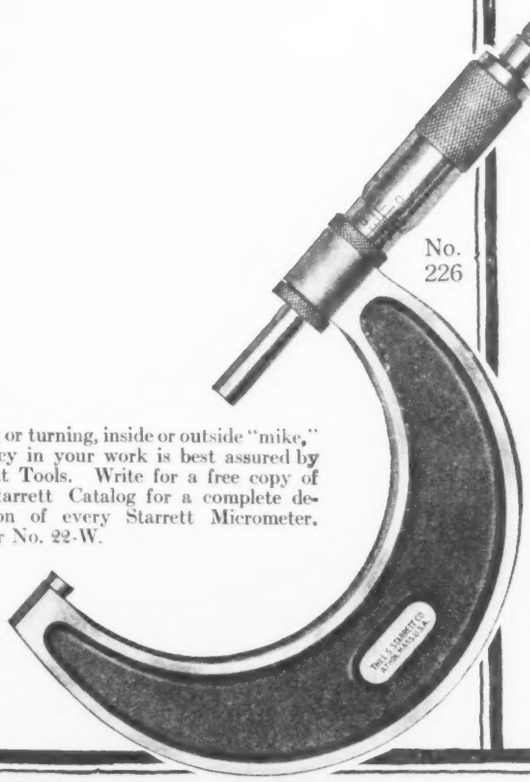

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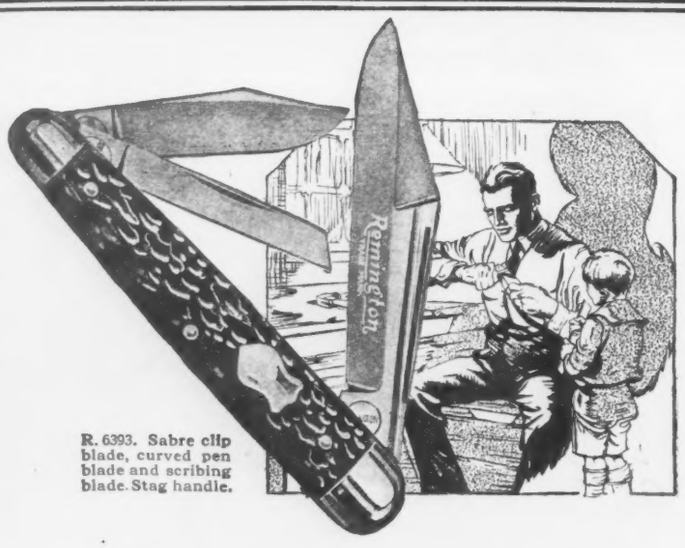

R. 6393. Sabre clip blade, curved pen blade and scribing blade. Stag handle.

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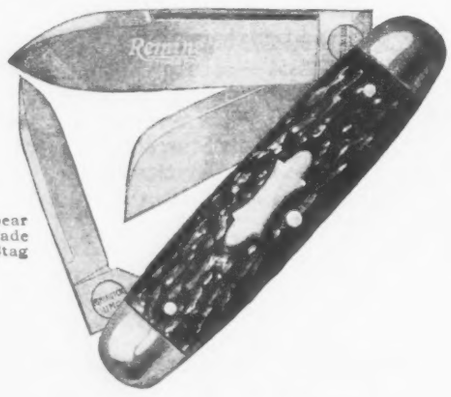

R. 3273. Strong spear blade, sheepsfoot blade and pen blade. Stag handle.

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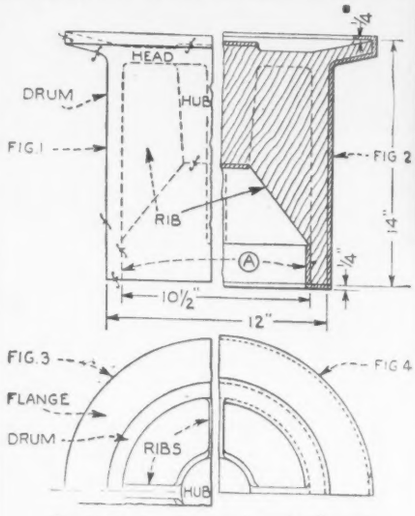
Simplifying a Rush Job in the Pattern Shop

By M. E. Duggan

What makes a mechanic successful? That really is the subject of this article by Mr. Duggan, who speaks with the authority of a man 44 years a mechanic and perhaps the best known foreman pattern-maker in the United States. In his story of a draftsman's thoughtlessness, a pattern-maker's indifference, and a foundryman's quick wit, he shows that common sense and cooperation are essential in solving the many puzzling problems that confront every mechanic.

A MECHANIC who knows his own little job will probably keep it. The man who knows how to do his job so that it will fit in well with the next man's, is the one who gets first consideration when there is a vacant foremanship. It is fatal for any mechanic to allow his own highly specialized work to absorb his interest to such an extent that he does not know what the previous man has done and what the next man is going to do.

Recently a striking and, to my mind, most interesting example of this came to my attention. A cast-iron drum had broken and the best promise that the manufacturer of the machine could offer



The finished surface at A made the pattern of this drum a puzzling problem

for a new part was delivery in about 12 days. So the mechanical department decided to do the job in the company's own shops.

The broken casting was taken into the drafting room for a drawing to be made. With great pains, a draftsman laid out the drawing, marking all surfaces to be finished as in the original. He completed his own little job to his own satisfaction and apparently it was correct in every detail. What he did not realize was that by a single *f* or finish mark on the drawing he had given the pattern-maker a job that would tax his ingenuity to the utmost.

The original casting (Figs. 1, 2, 3, and 4) had a finished interior surface (indicated at *A*) extending 4 in. up from the base, and this "finish" came mighty near finishing the pattern-maker. And there was no good reason for introducing this finish, as no other part fitted into it. The

(*Continued on page 90*)

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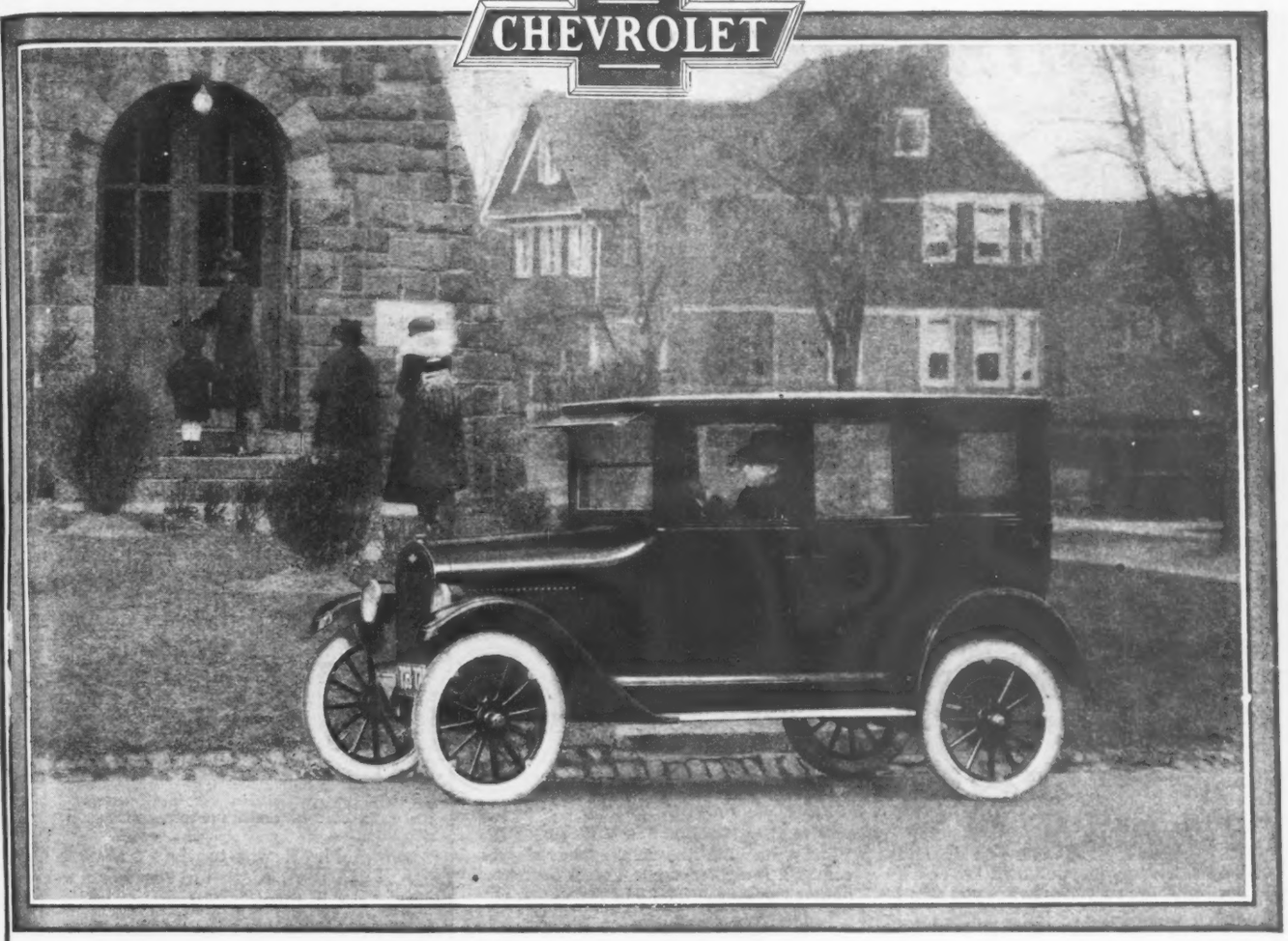

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Chevrolet prices are not the lowest on the market, yet Chevrolet economical transportation averages lowest in cost. This average cost considers the purchase price, interest on investment, depreciation and all operating and maintenance costs.

A detailed comparison with any other car in the low priced field will convince you that Chevrolet is the best buy because of its superior quality and because the purchase price includes full equipment.

More than a million Chevrolets are now in use. Twelve huge plants are now building them at the rate of two thousand five hundred per working day. Nearly one-half million Chevrolets were bought in 1923—far exceeding in number the sales of any other quality car.

Thus, our statements have the strongest possible backing, namely, the faith and patronage of the American people who know automobiles and know practical values better than any other people on earth.

Let any one of our seven thousand dealers show you our seven types of cars and explain how easy it is to get one and enjoy its use.

Chevrolet Motor Company, Detroit, Mich.

Division of General Motors Corporation

Five United States manufacturing plants, seven assembly plants and two Canadian plants give us the largest production capacity in the world for high-grade cars and make possible our low prices.

Prices f. o. b. Flint, Mich.

Superior Roadster	$490	Superior Sedan	$795
Superior Touring	495	Superior Commercial Chassis	395
Superior Utility Coupe	640	Superior Light Delivery	495
Superior 4-Passenger Coupe	725	Utility Express Truck Chassis	550

Chevrolet Dealers and Service Stations everywhere. Applications will be considered from high-grade dealers only, for territory not adequately covered.

CHOOSE *the* KEYBOARD *yourself!*

The New "XC" Corona

Now you can own a typewriter with a keyboard designed for you, personally! Mail the coupon and get the facts about this wonderful new machine.

TELL us the kind of work you do, and we will show you your own keyboard —fitted with the very characters you need!

Think of the joy of being able to write just what you want to write instead of turning out makeshift work with a typewriter that lacks the keys you need most.

Why this machine fits your work so well

First of all, it has 90 characters, 6 more than the ordinary office typewriter. That is the secret of its wonderful convenience—its adaptability to *your work.*

It is not a freak machine—nor is it complicated. It is simply a regular Corona, with every modern improvement—*with 6 extra characters added to the keyboard.*

Choose your own keyboard

Do you want a full range of fractions? You can have them. Or we can give you chemical or medical symbols, mathematical signs and exponents, or a full set of accents for foreign languages.

With a machine like this, typewriting becomes a real pleasure. You'll do better, neater work with far less effort.

And the price is low

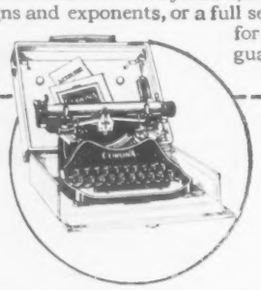
Only $55 for this 90-character model, including the neat carrying case—and with a keyboard of your own selection. (The price of the 84-character Corona is still $50.)

It's a typewriter you'll be proud to own, a fine-looking machine, and just as good as it looks! It has every Corona convenience, including the wide carriage, the two-color, automatically-reversing ribbon, back spacer, margin release, etc.

Proved Durability

Corona has an eighteen-year record of Proved Durability. It is the best typewriter investment you can make.

Don't delay. Mail the coupon and let us tell you the address of a Corona store where you can see this new machine. There's no reason why you should deny yourself the pleasure and the profit of owning a typewriter that is really adapted to your work.



There is a Corona store near you where you can see this new model and arrange to buy on easy terms if you desire. Mail the coupon for full particulars.

CLIP HERE AND MAIL

Corona Typewriter Company, Inc.
112 Main St., Groton, N.Y.

Please send me full particulars about the New "XC" Corona. No obligation on my part. Also address of nearest store.

Name .....

Address .....

Occupation .....

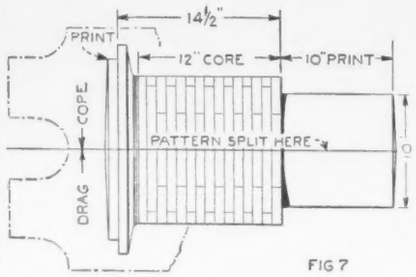
Simplifying a Rush Job

(*Continued from page 88*)

original manufacturer naturally wished the exposed end of the drum casting to revolve true, and the draftsman had unthinkingly provided for the same finish, overlooking the fact that now the great thing was to get the drum replaced and the machine in operation again.

How often a few strokes of a pencil by an unobservant draftsman either can simplify or complicate the work of pattern-maker, core-maker, molder, and machinist. In order to simplify work, the draftsman must know general pattern-making, foundry and machine-shop practice; otherwise time, labor, and material will surely be wasted.

The blueprint was then sent to the pattern-maker. He realized immediately that he would have a ring ¼ in. thick on the interior of the drum, which, if made fast to the drum, would project into the sand and lock the pattern firmly



The pattern built in segmental courses at a cost of much unnecessary labor

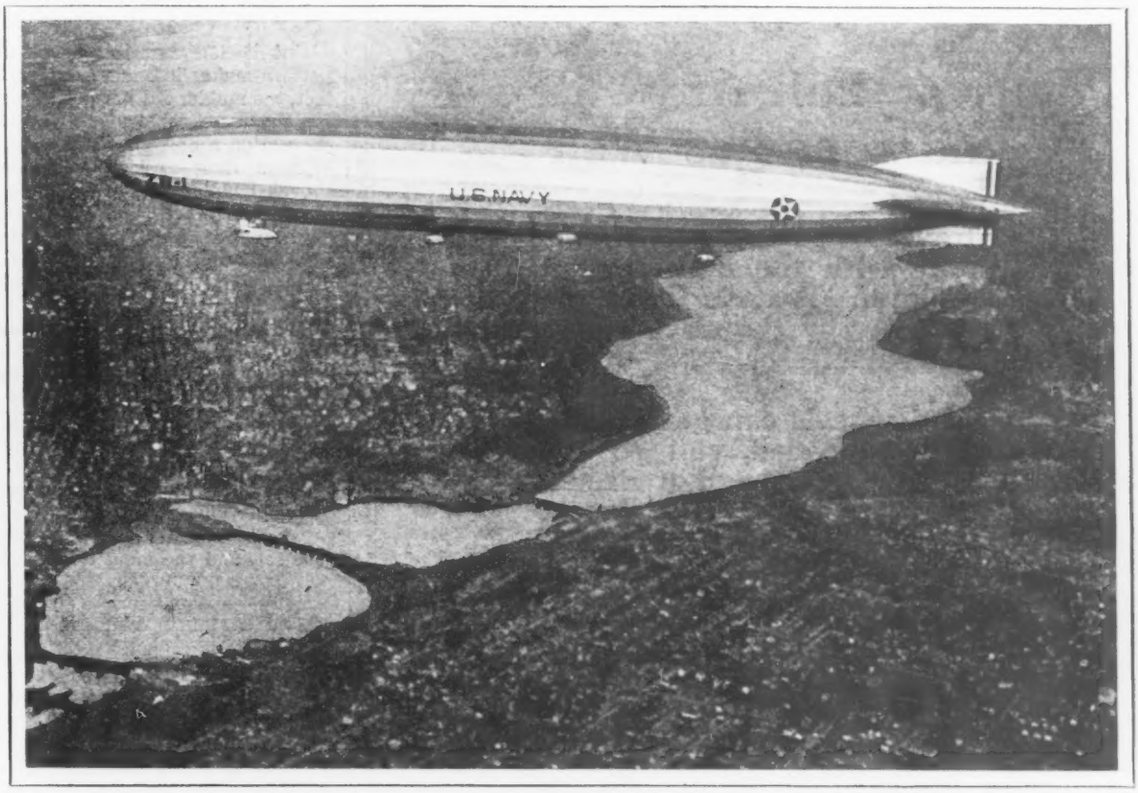
in the mold. It was too late to suggest changes in the design, for the work was wanted in a hurry. Moreover, he had learned that his job was making patterns and not telling the drafting department what to do.

After considerable study, he decided to make the ring in segments, loosely pinned to the drum pattern. The core-maker could then draw out the main part of the pattern and hook on to these segments and pull them out. The pattern was built in this way and sent to the foundry.

The core-maker shook his head when he saw the task laid out for him. In his estimation the pattern-maker should have known better than to have made the pattern in this way. It was contrary to the best molding practice. Besides, how were these little segments to be fished out of such a narrow cavity without damaging the side walls of the mold? And how were the walls to be patched if they should become torn up? He recognized it as the style of pattern-making known among foundrymen as "passing the buck."

The pattern-maker, not altogether certain whether he had done his job correctly, was curious about this particular casting and later on inquired about it. He was shown the finished product—a fine casting with the bugbear ring nicely in place within. Evidently he had made a good guess, and he patted himself on the back. While he did not know much about foundry practice, he had prepared a difficult pattern that WORKED!

(*Continued on page 92*)



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Please send me further information.
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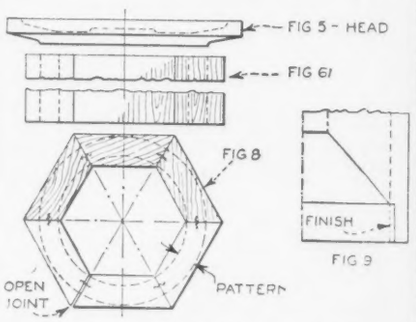
Address .....

Simplifying a Rush Job

(*Continued from page 90*)

But did it? Certainly not at all as the pattern-maker intended. As a matter of fact, the molder did not go fishing around for the loose segments. He placed the pattern on a bottom board, flange down. With a drag flask on the board, he shoveled molding sand in up to the top of the pattern. He next removed the dowel pins holding the segments, which were on top, and extracted the loose pieces from the mold. He placed slab cores, taken from the stock core shelves, over the circular cavity and continued filling in the sand.

The drag flask finished, the mold was rolled over and was then ready for the cope. The cope was made and lifted off, and the pattern was drawn out of the mold. There was nothing to prevent this because the segments were out of the way. The mold, drag and cope, was gated, mended in the usual manner, the cope set, and the mold closed. This was



The pattern as designed to give utmost economy both in pattern shop and foundry

practical molding practice, although the pattern-maker had not been aware of it.

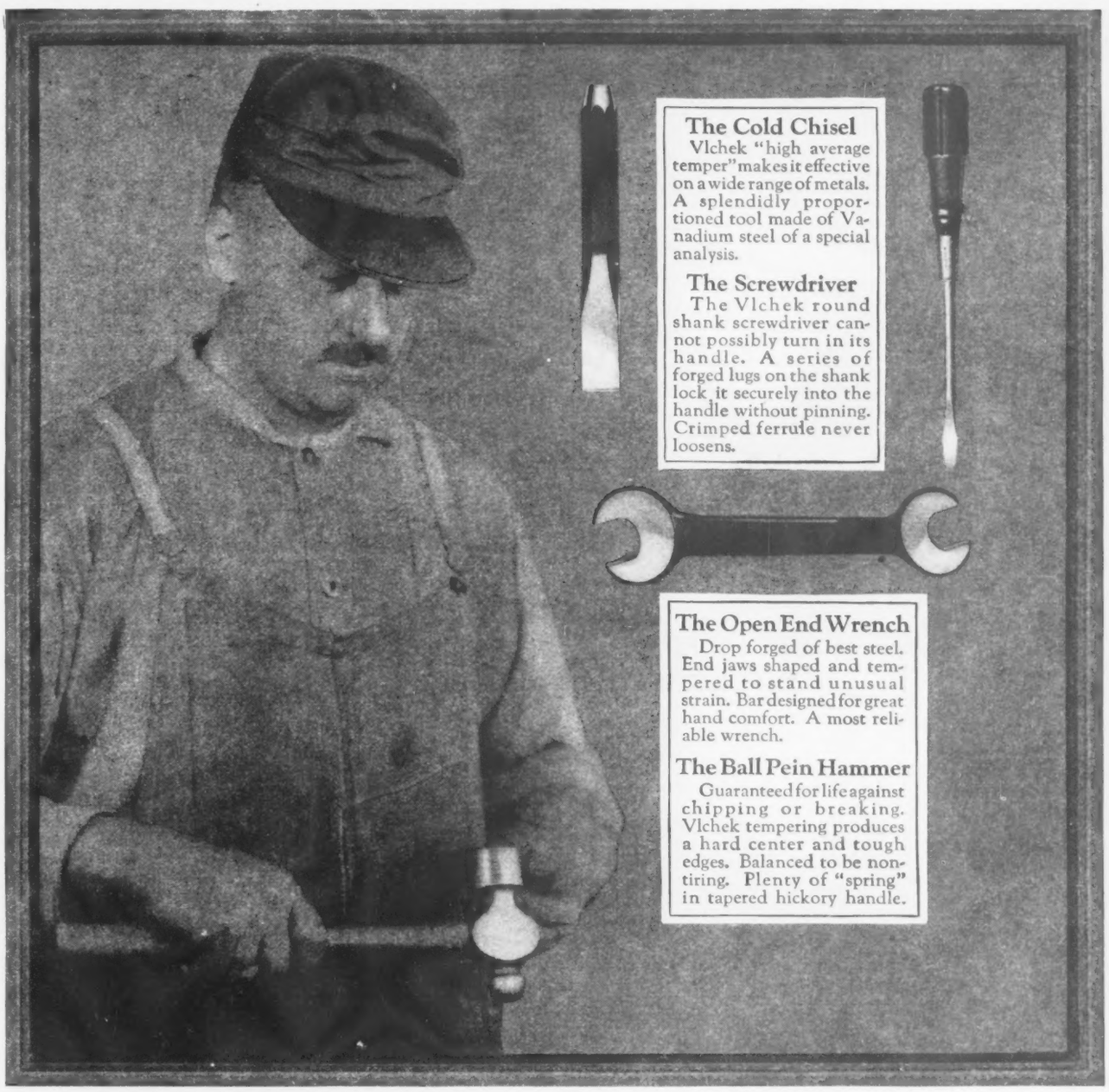
It is thus seen that even though the draftsman may complicate a design and the pattern-maker may fall in line with him by guessing at molding methods, the molder sometimes can help himself by using the pattern in a way the pattern-maker had not intended. One of the greatest drawbacks for the apprentice pattern-maker in the acquisition of practical knowledge is the "distance" between the pattern shop and the foundry.

In Fig. 7 (page 90) the pattern is shown built up in segmental courses, core print at the flange end, and balance print at the opposite end. The dish in the flange as well as in the interior of the drum is molded in dry core sand. For these core sections, core boxes must be made. This is a costly pattern and is built in a way contrary to the best practical methods, but it is a method often followed by the pattern-maker who is not thoroughly posted.

Suppose we simplify the whole job, starting with the draftsman. Let it be understood that the casting is wanted in a hurry and consequently refinements of design are not to be considered. The one thing necessary is to get the casting made and the machine started.

Make the bore 10 in. in diameter instead of 10½. This will provide for finishing without those annoying segment pieces. The extra metal will in no way

(*Continued on page 94*)


The Cold Chisel
Vlchek "high average temper" makes it effective on a wide range of metals. A splendidly proportioned tool made of Vanadium steel of a special analysis.
The Screwdriver
The Vlchek round shank screwdriver cannot possibly turn in its handle. A series of forged lugs on the shank lock it securely into the handle without pinning. Crimped ferrule never loosens.
The Open End Wrench
Drop forged of best steel. End jaws shaped and tempered to stand unusual strain. Bar designed for great hand comfort. A most reliable wrench.
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Guaranteed for life against chipping or breaking. Vlchek tempering produces a hard center and tough edges. Balanced to be non-tiring. Plenty of "spring" in tapered hickory handle.

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The steel, temper, design and balance of Vlchek tools—every basic fundamental—is the result of the application of exact science, infinite pains and close supervision. They are guaranteed tools although the name Vlchek on head or handle is all the guarantee a user ever requires. *Write for our catalog.*

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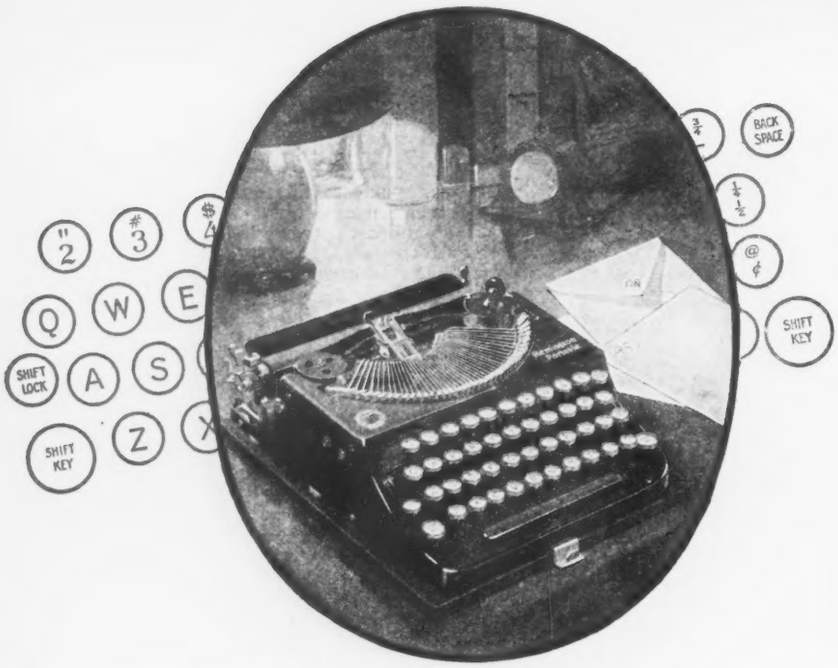

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REMINGTON PORTABLE

THE RECOGNIZED LEADER—IN SALES AND POPULARITY

Simplifying a Rush Job

(*Continued from page 92*)

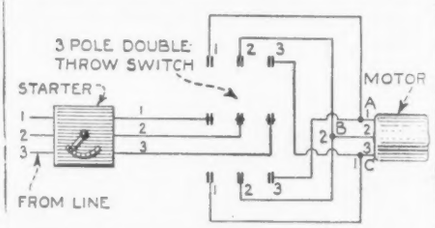
interfere with the purpose of the casting. On the contrary, it will give added strength to the drum.

In place of a built-up pattern in segmental courses, which involves increased labor, material, and time, turn the flange-head out of a single board (Fig. 5). Glue together six staves as shown in Figs. 6 and 8, leaving one open joint through which a bandsaw can be passed. Hold this together with a pinch dog and describe two circles to mark the outer and interior surfaces of the drum. Insert a bandsaw through the opening left for it and cut along the inside circle, making a slight bevel. Then repeat the operation on the outside.

If the job has been done well, it should be necessary to add only a sandpaper finish. Next, fasten the head to the drum and coat the whole with black varnish. By passing a lighted alcohol lamp over the surface, the alcohol can be burned away, leaving a hard and dry varnished surface. In this way it becomes unnecessary to wait three or four hours for the varnish to dry. Sandpaper the pattern and it is ready for the foundry.

Reversing an Electric Motor

THERE are times when the rotation of an electric motor must be reversed. With direct current it is necessary only to interchange the line connections of either the armature or field. If both are inter-



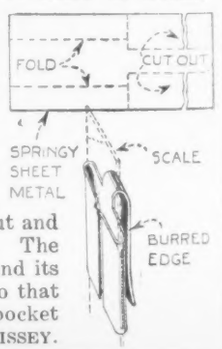
Wiring diagram, showing use of three-pole, double-throw switch to change motor's rotation

changed, the motor will continue to run in the same direction.

With alternating current, interchange any two of the three wires leading from the starting box to the three-phase motor. A convenient way of doing this with a three-pole, double-throw switch is shown in the accompanying diagram. It will be noticed that while the line marked 2 remains the same, the switch provides means for interchanging lines 1 and 3.—JAMES F. HOBART, Dunedin, Fla.

Holder Prevents Loss of Scale

A MECHANIC can make a clip for his steel scale that will hold it in the same way as a clip holds a pencil. A piece of springy sheet metal about 4 in. long and 3 in. wide is cut and bent as shown. The tongue is curved and its edges are burred so that it will grip the pocket firmly.—E. J. MORRISSEY.



ATKINS SILVER STEEL SAWS

No. 10 Hack Saw Frame

Hard rubber handle, "easy grip" pattern; hung low, thus directing force of stroke on a line with cutting edge of blade. Frame of cold rolled steel 3/16-inch thick and ¾-inch wide. Nickeled and highly polished; adjustable to 8, 9, 10, 11 and 12-inch blades.

No. 400 Hand Saw
Skew Back—Ship Point

Finest saw on earth; extraordinary in quality, workmanship and finish. Genuine SILVER STEEL BLADE, 26-inch length, five gauges, taper ground. MIRROR POLISH. Solid ROSEWOOD HANDLE of the Improved Perfection Pattern. Nickeled Screws. Skew or Straight Back.

No. 53 Hand Saw

Regular Pattern. A popular saw. Made of SILVER STEEL, taper ground, and given Atkins exclusive Damaskeen Polish. Fitted with Atkins Improved Perfection Handle, which eliminates wrist strain. Cuts fast and easy; holds edge longer. Also in Ship Point Pattern.

Junior Mechanic Saw

This is a new saw for the Boy Scout as well as the junior and radio mechanic. A handy saw for home use. Made 20 in. long, skew back, nine points, taper ground, highly polished; cherry handle, mission stained. Every home needs one.

No. 3 Nest of Saws

This handy set of saws includes 12-inch keyhole blade, 14-inch compass blade and 18-inch special nail-cutting blade, all interchangeable in the adjustable handle.

If your dealer hasn't the Atkins Saw you want—write us, and we will see that you are supplied.

Atkins No. 10 "Easy Grip" Hack Saw Frame shown in illustration above. Frame is adjustable to use 8 to 12 inch blades.

AAA Hack Saw Blades Cut Faster, Run Easier and Do Not Break

PUT an Atkins Non-Breakable Blade in your hack saw frame, and you'll feel the difference at once. It will saw the toughest metal much faster and easier than ordinary blades, hold its cutting edge longer, and will not break.

These blades are made of selected steel, and hardened and tempered by an exclusive gas-and-oil process, which gives each blade a hard, keen-cutting edge and a tough, flexible body. Send 10c for a sample blade—(Tell us what metal you want to cut).

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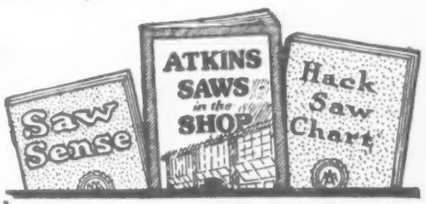
No matter what kind of a saw you require—hack saw, hand saw, compass saw, keyhole saw, cross-cut saw, circular saw, buck saw, meat saw, pruning saw, drag saw, or in fact, any saw for any wood or metal cutting purpose—there is an Atkins Saw that will do the work quicker, better and easier.

Write us for free booklets on any saws you are interested in.



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"Saw Sense" shows you the best saw for every use, tells how to test and file saws and gives helpful tables and facts on building work.

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—Williams' lather is heavy and closely woven. It holds the moisture in. Result: faster and better softening of the beard.

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—Williams' keeps your face in comfort after the shave. There's an ingredient in Williams' that's decidedly beneficial to the skin.

Williams' is a pure, natural-white shaving cream absolutely without coloring matter. The best-known shaving soap specialists make it. Try a tube—with the new Hinge-Cap—see if you ever used a shaving cream as fine!

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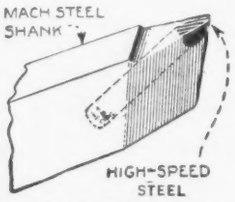
Williams' Shaving Cream

High Speed Toolbits Retained in Holders by Shrinkage

By W. Burr Bennett

MACHINISTS generally are familiar with the use of high-speed tools of the usual 18-4-1 mixture (tungsten, vanadium, and chromium). These tools are used as a solid forged tool, are welded to a machine steel shank, or held in a shank with a setscrew. The welded bit is generally conceded to be next best to a solid tool, as, in addition to its economy value, it has heat conductivity and is more rigid. However, the majority of small shops and some large ones do not have the facilities for welding.



The shank is shrunk over the toolbit

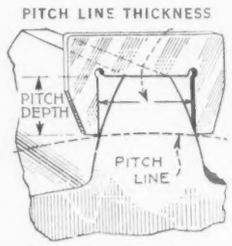
The accompanying illustration shows how an inserted toolbit can be made at a very low cost with all the advantages of the welded tip and some others that the welded tip does not possess. The shank can be made of ordinary cold rolled or machine steel, but if stiffness is needed, it is better to make the shank of straight carbon tool steel.

Drill and ream a round hole for the high speed bit, making the hole about .010 in. smaller than the diameter of the bit. Purchase a treated bit of the size required and see that the surface is smooth. Put the shank in the fire and heat until it is a bright red. Clamp the tail end in a vise, drive home the bit, and quench in water.

The principle involved is that of driving home the bit in the semiplastic shank; and then insuring the fit by shrinking the shank around the bit by the water quench. The suggestion that the bit be purchased ready treated is made in view of the fact that relatively few small shops have the correct equipment for correctly treating high-speed steel.

Gear-Tooth Pitch Gage

A SIMPLE and accurate gear-tooth pitch gage can be made as illustrated out of sheet metal from 1/16 to 1/8 in. in thickness. When case-hardened, it will stand hard wear. Both the addendum or pitch depth and the thickness of tooth can be found in handbooks or calculated and should be carefully laid out on the sheet metal. The gage is applied to find the proper depth to sink the cutter.



How the gage is applied to a gear tooth

When the points of the gage just touch the tooth's flank face, the gage should rest squarely upon the tooth surface. This being true, the points are exactly on the pitch line or pitch point.

This gage may be used for either spur or bevel gears. In gaging bevel gears the gage should be applied at the extreme edge on the large end of the tooth.—H. W.

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In the simple act of lifting the telephone receiver from its hook every subscriber becomes the marshal of an army. At his service, as he needs them, a quarter of a million men and women are organized in the Bell System. One skilled corps of the telephone army moves to place him in talking connection with his neighbor in the next block, in the next state or across the continent. Another highly trained corps is on duty to keep the wires in condition to vibrate with his words. Still others are developing better apparatus and methods, manufacturing and adding new equipment, and installing new telephones to increase the subscriber's realm of command.

The terrain of the telephone army is the whole United States, dotted with 14,000,000 instruments, all within range of the subscriber's telephone voice. Even in the remote places this army provides equipment and supplies. Its methods of operation are constantly being improved, that each user may talk to his friends with increased efficiency. Millions of money are spent in its permanent works. Yet its costs of operation are studiously held to the minimum, that the subscriber may continue to receive the cheapest as well as the best telephone service in the world.

The permanent objective of the Bell System army is to meet the telephone needs of the nation—a hopeless task were not its command unified, its equipment adequately maintained and its personnel trained in the latest developments of telephone art.

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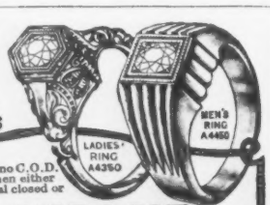

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Solid Forged Lathe Tool *versus* Toolbit and Holder

Among the interesting letters received from readers in response to the invitation for a general discussion of an article, "Getting the Most Out of Your Lathe Tools," in the January issue, are the following:

By E. O. Dygert, Cle Elum, Wash.

Having been a reader of Mr. Romig's articles for some time, I took great interest in the one on "Getting the Most Out of Your Lathe Tools." As I have been in harness since before the day of high speed steel, I well know the value of a substantial forged tool.

Turning 14-in. crankshafts and tailshafts in marine work, Lloyd's specification, for Shipping Board engines, we never attempted to use anything but forged tools. They stood up under the heavy cuts necessary on this work, and the aim was maximum production.

In lathe work the most efficient tool is found by taking the product of the tool travel over the surface of the work in feet by the weight of metal removed a minute, for one grinding of the tool. It will invariably be found that high speeds and light feeds are unable to produce the results of slower speeds and heavier feeds.

I can vouch for the correctness of Mr. Romig's belief from my own experience, as it accords with his at every angle of his discussion.

Give me a good substantial forged tool for roughing, let the other fellow select any other kind, and I can assure you that he will fall far behind in any production test.

By F. J. Wilhelm, Cincinnati, Ohio

IN SPITE of the excellent arguments made by Mr. Romig in his article on lathe tools in the January POPULAR SCIENCE MONTHLY, my experience has been that the toolbit in most cases is a wonder for production.

For roughing heavy forgings such as are made in large steel mills (and the writer has had quite a little experience with such work), it is true that the forgings are rather large and oversize because the blacksmiths work on tonnage, but it must be remembered that large forgings always go on large lathes. Large lathes take large toolbits and everything is in proportion, and it is no harder to use a large toolbit than a small one. So far as the amount of heat is concerned on large work, I have never seen a piece of really high grade steel burn up under the heaviest cut.

For finishing work, when the toolbit is properly ground for finishing and then rubbed with an oilstone and a little oil along the edge to remove the rag that the emery wheel has left, finishing work can be done very nicely and inexpensively.

So far as the shell-turning job referred to by Mr. Romig is concerned, the writer has designed special lathes, built them, and kept a battery of them running without any trouble with toolbit tooling. We ran on surface speed at 35 ft. a minute with a 3/32-in. feed, using one roughing and one finishing cut.

Neptunite

Never turns white

WHEN the well-informed painter selects his varnish for work of especial importance, he chooses Neptunite. He has found that, in finishing a floor, Neptunite, with its heavy body and slow-setting quality, gives ample time for careful working. He knows that it levels perfectly, dries quickly to a hard surface, and makes a gleaming, lustrous floor that enhances the beauty of the natural wood grain, yet whose mirror-like surface reflects in subdued tones the color harmony of the room.

He knows too, that the beauty of Neptunite is a permanent beauty, resisting the wear of scuffling feet, the action of steam or mud or melting snow. He knows that Neptunite never turns white. It doesn't even scratch white.

There are four Neptunite Varnishes—each created to do one thing well—for floors, Neptunite Floor; for exterior work, Neptunite Spar; for woodwork, Neptunite Interior and for a rubbed finish, Neptunite Rubbing.

Neptunite is carefully made, and just as carefully sold. Only *one* dealer—the Lowe Brothers Dealer—in your community can supply you. From him you can be assured of getting not only high quality paints and varnishes, but also sound advice as to how to use them.

For fifty years experienced paintmen, painters, decorators, architects and home owners have recognized the high quality of Lowe Brothers "High Standard" Paint—rich colors that retain their newness for many years—protective ability against wear and weather—capacity for covering so that less paint is required for the job. You will find beauty, protection and real economy in the use of this paint.

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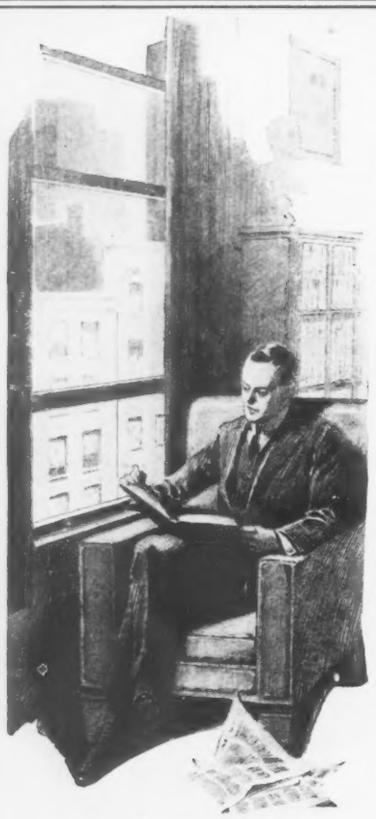

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TO KNOW?

Many times a day you face situations that compel you to draw upon your reserve of knowledge. It may be in the office or among business associates, it may be at the club or in a social gathering. It may be in any of the activities that make up every-day life. What is it worth to you in influence and leadership, in *dollars and cents*, to meet these demands without hesitation? What is it worth to you to be the *man who knows* and win the admiration of your friends, the respect and confidence of your associates? Your success and satisfaction in life rest so largely upon your reserve of knowledge that you must, in your own interests, have readily available such an infallible source of knowledge as THE

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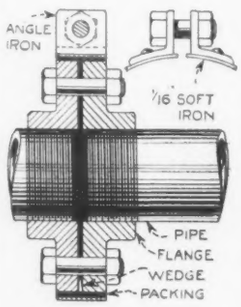
Making Temporary Repairs to a Blown-Out Gasket

IT SOMETIMES happens that the gasket between two flanges in a steam line will spring a leak at a time when it is impossible to stop work and make a proper repair to the joint. In one such emergency a temporary repair was made by driving a wedge of pine into the crack after the steam had been shut off, and cutting it off flush. A piece of rubber steam packing was placed around the flange and held tightly in place with an iron band, resembling a brake band. The band was made of 1/16-in. soft iron with a length equal to the circumference of the flanges. The lugs for drawing it tight were of 1-in. angle iron, riveted ½ in. from the ends and brazed. Before placing the packing, the joint was covered with pipe joint cement.



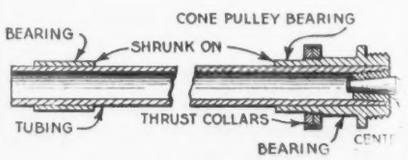
How the blown gasket was fixed

The steam was turned on and the bolt in the band followed up a little at a time until it was solid. No leak has as yet appeared.—A. S. JAMIESON, Springfield, Mass.

Fitting an Old Lathe with a New Hollow Spindle

AN OLD lathe with a solid spindle may be improved greatly by fitting it with a hollow spindle. Since small shops are not usually equipped with facilities for deep drilling, the spindle cannot be made easily from a forging. It is possible, however, to construct the spindle from a piece of seamless steel tubing of a length and diameter to conform to the lathe.

The tubing is first centered and turned down for a distance of about 12 in. to



The new spindle is made of seamless steel tubing with bearing pieces shrunk on

receive the bearing pieces. The pieces for the front and back bearings (mild machine steel) are then rough turned and bored, allowing for shrinkage. After being centered, the assembled spindle is finished and the thread for the thrust collar is cut. The last operation is to cut the thread on the spindle nose and bore the taper hole.

The spindle is improved still more by fitting a set of spring draw-in chucks. In redesigning a lathe spindle the bearings should be enlarged as much as the headstock design will permit.—H. L. WHEELER.

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Length - - 12½ in. Weight - - 1¾ lb.

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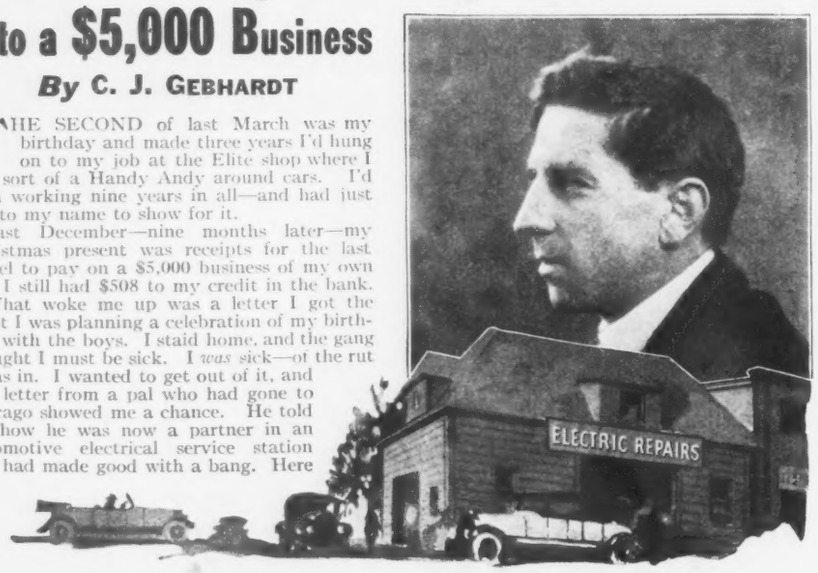
Stretching a Fifty-dollar Bill

Into a $5,000 Business

By C. J. GEBHARDT



THE SECOND of last March was my birthday and made three years I'd hung on to my job at the Elite shop where I was sort of a Handy Andy around cars. I'd been working nine years in all—and had just $50 to my name to show for it.

Last December—nine months later—my Christmas present was receipts for the last nickel to pay on a $5,000 business of my own and I still had $508 to my credit in the bank.

What woke me up was a letter I got the night I was planning a celebration of my birthday with the boys. I staid home, and the gang thought I must be sick. I *was* sick—of the rut I was in. I wanted to get out of it, and this letter from a pal who had gone to Chicago showed me a chance. He told me how he was now a partner in an automotive electrical service station and had made good with a bang. Here in Harrisburg he hadn't even been in the automobile game. So I was plenty interested in what that letter had to say! Here's the part that woke me up:

"It doesn't take a detective to find a broken spring or a loose clutch," the letter ran, "nor a master mechanic to fix such things. It's the fellow who knows that the big money in the automobile line is in the electrical work—and knows how to handle it — who gets on." Then came the eye-opener. I learned that automotive electricity only *seems* complicated and is really quite simple. Everything electrical on any car, and everything that can happen to it, falls in one or the other of only three classes. Certain tests tell which of these three divisions all electrical trouble is in, and once you have that information you can put your finger on what's wrong. *I found how I could master automotive electricity in fifty days, and I did.* You can do it too, if you'll take five minutes to read this explanation and let it sink in:

You can't *see* electricity, and you can't take hold of it, so you have to locate electric troubles with your *head*. Once you get the course of electric current in your *mind* it's as simple as the flow of water, and the leaks are just as easy to find. Let someone who knows give you the knack of thinking *electrically*—and you can find what is wrong, fix it, and have the money in your pocket while the fellow who has to guess is wondering what to try next! All that's needed then is a little practice with the instruments that detect and measure electric energy, and you can just about pick your own employer or else do as I did and strike out for yourself.

I put in exactly fifty days getting the principles of electricity down pat and getting confidence doing practical jobs on every sort of motor and generator. I never could have dug it out of books. I doubt if I ever would have got it from watching others. My first move after I had taken this shortcut to really knowing electricity and what it was all about was to try myself out here in town. I took an electric repair job in one of the biggest garages in town, at $35 a week.

The first morning, in rolled a bus wired like a Chinese puzzle, with a generator like nothing I'd ever come across; and the owner had a whole list of things that were wrong. I admit that I would have slipped out of the shop if I hadn't hung my coat in the boss' office. But I figured that electricity is electricity, and if the things I'd learned weren't equal to any occasion I was going to find it out there and then. So I put all the switches the way I knew they ought to go for my first test, took the readings I'd learned to make for classifying the trouble whatever it was—and it worked!

I had the difficulty nailed inside of half an hour, and by noon I had that car all set. When the customer told me he had had his car to two other places that had been stumped on that job, it made me feel pretty good.

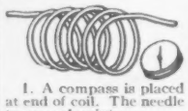
I put in about a month when I got raised to $50 a week without asking for it.

Two months later, the delivery superintendent of the store that sent all its cars to our shop put it in my head to start up for myself. He got me the use of an old barn of the company's and I soon had enough other work to keep me and two others busy. In almost less time than you'd believe it could count up I had enough cash to pay down a thousand dollars toward buying the building and we put in a new floor and some benches and other conveniences. I guess I must have nearly a thousand dollars worth of tools and instruments, now, too, although I didn't have many nor need so many at the beginning. As I have said, the business is all mine now, and all paid for, and I drew $75 a week for myself from the day I opened up shop.

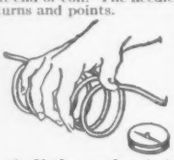
I haven't told all this to brag about myself or how smart I am, but in hopes it would be a help to someone who may be like I was hardly over six months ago—dubbing along in the dirt and grease, and kidding myself I was in the automobile business. Also, I want to give the credit where the most of it is due—the institution that planted principles of electricity in my head in such a way I could use them and turn them into cash. It was the Ambu Engineering Institute in Chicago that gave me my start. So far as I know, it is the only place in the country where automotive electricity has been reduced to such simple terms that any fellow who can't master it is simple himself. It is so easy that even the little book they send you free will prove the whole proposition to you in half an hour. And I am glad that I sent for it!

Can YOU Think Electrically?

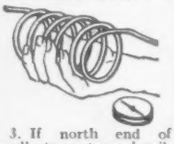
This 5-Minute Test will tell if your mind runs to mastery of automotive electricity. Suppose you had to know which way the current is going in coil below:



1. A compass is placed at end of coil. The needle turns and points.



2. If the south pole is toward coil, grasp coil with right hand—thumb toward compass. *The fingers point the way current is moving through coil.*



3. If north end of needle turns toward coil, grasp coil so thumb points away from compass. *Fingers point the way current is going*—in opposite direction from No. 2.

IF ABOVE IS CLEAR TO YOU then you can learn automotive electrical principles! It is all just as simple and sensible as this. You are wasting your time by not *knowing*.

C. J. Buckwalter, Pres.
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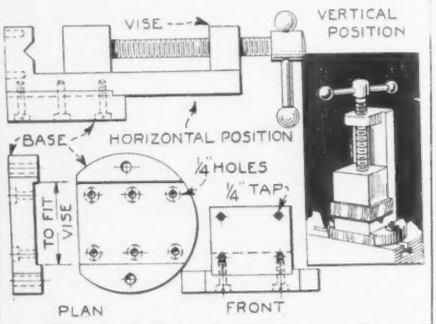
Base Adapts Small Tool Vise for Machine Use

WHEN fitted with a base, a small machine vise of the ordinary variety designed for holding small parts for drilling, can be used to good advantage on hand millers, grinders, and other machine tools.

To make such a base, turn a disk of cast iron to a suitable diameter, face it on one side and cut a groove in a shaper through the center to the depth of ⅛ in. and exactly as wide as the vise. The base is then drilled for two hold-down bolts, either ⅜ or ½ in. Small holes are also drilled and counterbored as shown for the screws that fasten the vise to the base, either in a horizontal or vertical position.



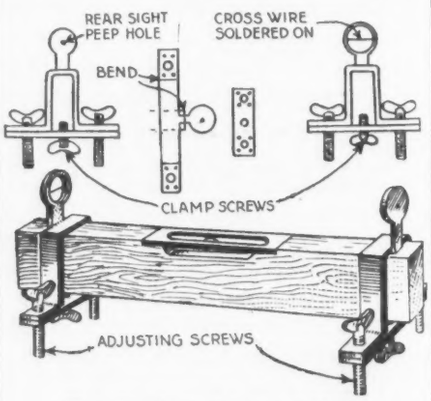
The vise is fastened either horizontally or vertically to a special cast-iron base

Facing off the base so that it will be flush with the top of the vise, when the vise is in the vertical position, allows the work to be clamped close to the forward edge of the worktable. That is often a great advantage for end milling with short cutters.—V. R.

Sights Adapt Carpenter's Level for Grading and Fencing

A BUILDER'S level or a surveyor's transit is not always available when fences, walls, farming, or grading operations are to be laid out. An ordinary carpenter's level may be made an effective substitute in all sorts of such lining-up jobs.

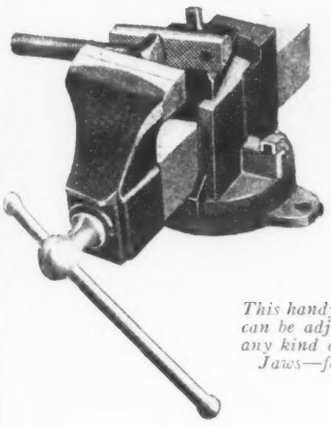
Two sights to fit the level are purchased or made, one with a peephole of about 1/16 in. diameter and the other with a larger hole that has a horizontal length of thin wire soldered across it. The two side screws on each sight are used to level up the instrument upon any convenient and relatively flat surface.—G. L.



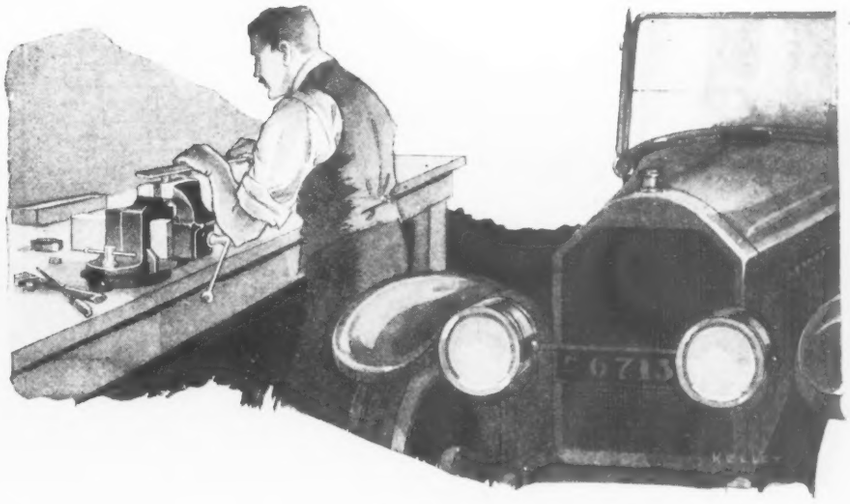
How the front and rear sights are attached to a wooden or metal level

PRENTISS

The Vise that Holds Work and Friends!



This handy vise with swivel base, can be adjusted at any angle for any kind of work—"Bull Dog" Jaws—for 'all-around' use.



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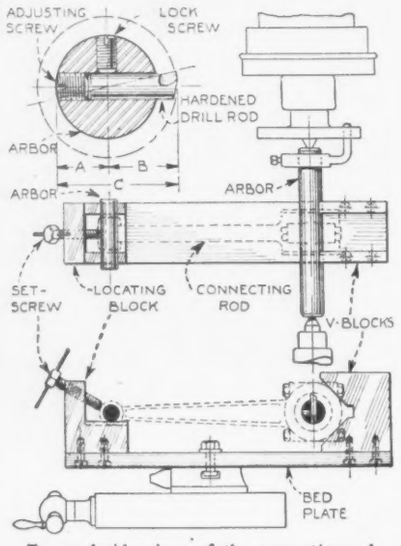
Fixture Simplifies Reaming of Rebabbitted Connecting Rods

AUTOMOTIVE repairmen more or less often are confronted with the job of rebabbitting and reaming or boring out the crankshaft end of connecting rods. While fixtures for this work are on the market, small shops can do the job well with a simple device that can be attached to the cross-slide of a lathe.

Two V-blocks are fastened to one end of a bedplate, and a locating block, with sides accurately parallel, is attached as shown to the other end. A setscrew in the block serves to force the wristpin end of a connecting rod down between its parallel sides as well as pressing the crankshaft



Top and side views of the connecting-rod fixture and details of boring rod and tool

end into the V-blocks. A small arbor in the wristpin hole bears on the parallels and keeps the axis of the hole to be reamed horizontal, while the arbor with the cutting tool, which is carried between the lathe centers, keeps the axis correct in the vertical plane.

Referring to the accompanying cross section of the arbor, the distance *B* represents the radius of the finished hole and *A* is the radius of the arbor. If the tool is set accurately by means of micrometers, and has a broad, smooth edge, there will be no necessity for scraping after the finishing cut has been taken.

In babbitting such a job, only metal with a tin and not a cheap lead base should be used. While an 80 per cent tin alloy will require a very hot ladle and rod to pour, the results will well repay the effort. Pour the babbitt on an arbor about ⅛ in. smaller in diameter than the finished bore. After it has cooled, take the cap from the rod and carefully peen each half, making sure not to peen too deeply. Then bolt the cap to the rod, and the job is ready for this fixture.

AN EXCELLENT leather cement can be made of equal parts of good hide glue and American isinglass, softened in water for 10 hours and then boiled with pure tannin until the whole mass is sticky. The surface of the joint should be roughened and the cement applied hot.

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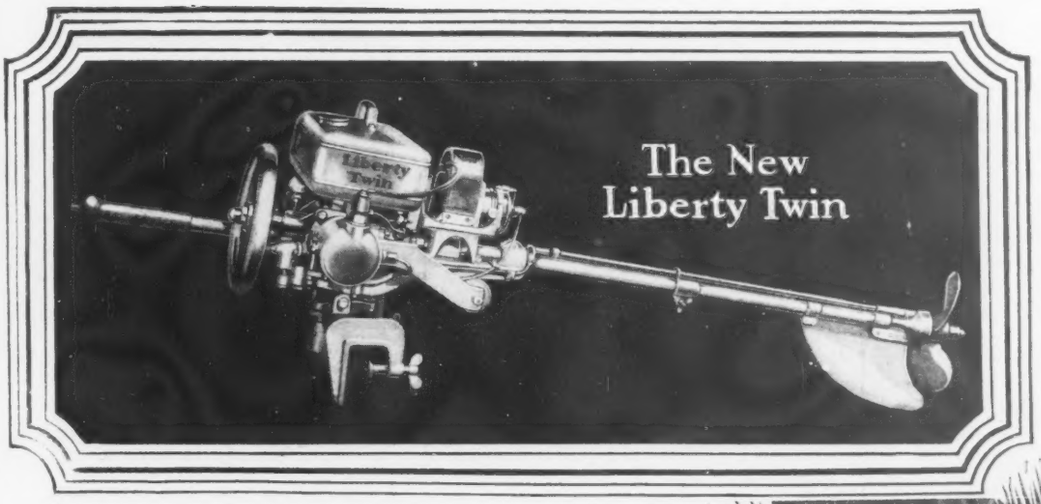

View below shows how the propeller can be locked up out of water if desired.

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Bosch Ignition—Zenith Carburetor—Direct Drive

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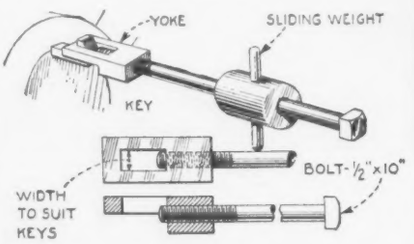
Stubborn Keys Drawn by Means of Hammer-Like Puller

IT IS often difficult to remove machine keys without damaging the heads, for the reason that they have been driven home hard with a hammer. A simple form of key puller that will accomplish this is made as illustrated.

A block of machinery steel is shaped as shown, then squared to fit loosely over



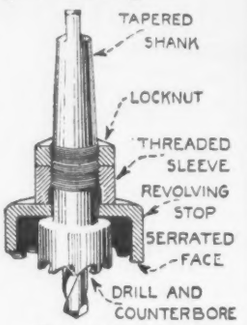
This type of machine-key puller will not damage the heads of firmly fixed keys

the head of the key. The rear of the block is left thick and heavy and is tapped for a ½-in. bolt about 10 in. long. A weight is made to slide freely over this bolt. This weight either can be knurled or have two handles fitted to it. The yoke member of the puller should be case-hardened to increase its strength.

When the weight is pulled back against the head of the bolt, a hammer action is produced that soon loosens the key.

Serrated Depth Stop for Drilling and Spot-Facing

SPOT facing the surface of either plate or castings for boltheads simultaneously with drilling the holes, can be done effectively with the tool illustrated. The loose revolving stop with a serrated face enables the drill-press operator to control the depth and still overcome scraping or side strain difficulties that would be caused by using an ordinary depth gage.



Used with combination drill and counterbore

The drill and countersink is made as usual, while the stop arrangement is a sleeve fitted about the shank with adjustable threaded collars above it.

FEATURES FOR APRIL

"INGENIOUS Work-Holding Fixtures," by F. J. Wilhelm, will appear in the Better Shop Methods Department next month.

W. Burr Bennett will describe a simple nut-tapping fixture; Frank N. Coakley will give details of a homemade valve grinder for the garage man; Donald A. Price will give a design for an eccentric foundry flask clamp; and George A. Luers will explain a new one-piece tool for refitting engine valves.

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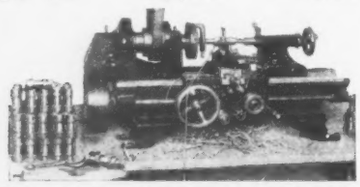

South Bend Lathe Works
575 E. Madison St. South Bend, Ind.

Speedy and Accurate Boring

(*Continued from page 86*)

hole through the bar accommodates a continuous shaft. The shaft terminates at one end in a pinion; to the opposite end is fitted a wormwheel. Small racks are machined in the cutters (or made separately) so that these will mesh with the pinion. The wormwheel at the other end is turned by a worm fastened to a shaft extending crosswise of the bar. A dial is graduated to indicate the amount of movement of the tools when the wormshaft is turned. The final cut is made when the pointer is at some specific number on the dial.

This type of exterior adjustable bar has given more satisfactory service than any

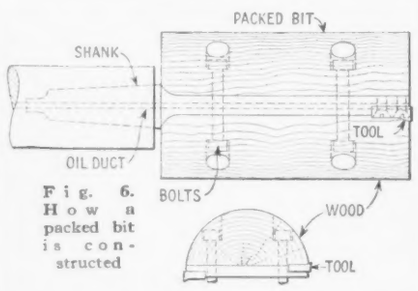

Fig. 6. How a packed bit is constructed

of a hundred others that have been tried out in one large manufacturing plant, and its construction is applicable to practically every job of recess boring that a machinist is likely to encounter.

It may be well to bear in mind that makeshift tools can be a source of much lost time and effort. Such tools frequently are broken or turn off the boring bar. As a result, either the work is spoiled or the tool is jammed into the recess and many hours of labor are required in extracting the parts.

A glass-smooth finish is often required in the bore of steel tubes such as are used in pneumatic or hydraulic machinery and in guns and rifles. The tool used to obtain this is not generally familiar to machinists.

With a packed-bit boring tool the finishing cut can be made as free of tool marks and as smooth as though it had been finished with polishing materials. A detail sketch of the packed-bit tool is shown in Fig. 6. There must be a wood packing about the cutters; steel cannot be used. The cutter holder can be any

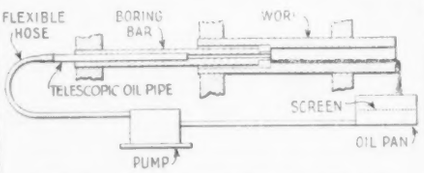

Fig. 7. Using a telescopic oil pipe and hollow bar for thorough lubrication

shape of steel plate slightly smaller in width than the bore of the cylinder. A shank or bar to fit the machine boring bar is provided, the cutter being a separate head for the purpose of removal, setting or sharpening the blades, and repacking.

The tools are usually screwed on and finished in the holder. The wood is either oak or hickory, although other hard wood will serve. These sections are bolted to

(*Continued on page 110*)

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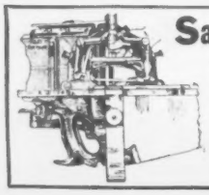

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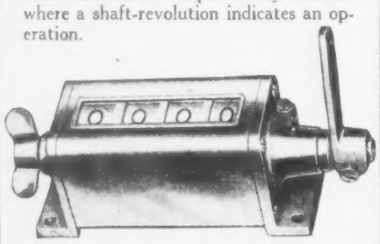

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Speedy and Accurate Boring

(Continued from page 108)

the holder and turned on the lathe, to a diameter of two or three hundredths of an inch larger than the bore to be finished.

As the tool enters the work, the hardwood packing on the head follows, supporting the tools from every side and preventing any possible chatter. A continuous flow of oil must precede the cutters so as to wash away all chips. A few chips are bound to get by, but these do no damage, since they become embedded in the wood. This is the most serviceable of all tools for securing a smooth bore.

An important element to be taken into consideration with all boring is proper lubrication. Machine oil or some equally good fluid lubricant should be used unsparingly, for it decreases the friction, prevents gouging caused by chips and avoids galling of the boring bar and other moving parts. Oil carries off the heat produced by the cutters as well as removing the chips.

Feeding Oil to the Cutters

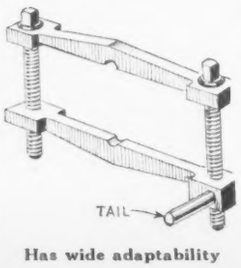
Methods for getting oil to the cutters vary. In some cases oil is fed through a hole running the length of the bar. A pump forces the oil into this tube through a flexible hose; the oil runs out at the other end and is caught in a screened pan and brought back to the pump for recirculation. Where a pump is not available, an elevated reservoir can be used to feed the oil. All oil should be screened before being returned to the reservoir. Figure 7 shows a method giving continuous oil supply.

Where entrance is to be had at the end of the work opposite the bar, a small copper or brass pipe can be inserted through which oil can be run from an elevated reservoir. In some instances this method cannot be employed. The open end is then blocked with a disk fitted with a central hole for housing a loose extension from the bottom of the oil container. The oil is thus blocked against running out at the end of the tube and flows back past the cutters and out at the boring bar end of the work.

If you use the proper tools, have these in the best condition, lubricate all work well and adhere to approved practices, you will not be likely to suffer the experience of Joseph Dyson.

Universal Lathe Dog

THIS lathe dog will grip work within a large range of diameters. Two pieces of ½-in. square steel about 3 in. long are shaped as in the figure, with the center left wider to add strength where the piece is grooved. One piece is drilled and the other is tapped to receive 5/16 in. 18 thd. machine screws. A ⅜-in. stud is screwed and riveted in place to serve as a tail. — C. A. P.



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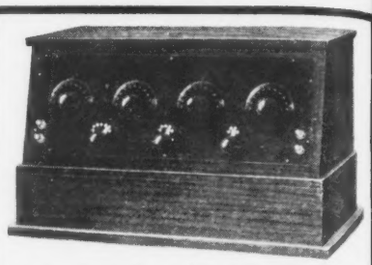

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SILVER-S BATTERY CO.
1356 Michigan Ave. Dept. PS Chicago, Ill.

UNCONDITIONAL 2 YR GUARANTEE

Six Machines in One

Combines bench saw, sander, drill, grinder, polisher and buffer for working in wood and soft metal

Boice Pony Bench Machine

—a precision machine especially adapted for rapid and accurate work. Handles 4" abrasive grinding wheels, 6" saws, 6" and 8" sanding disks and ⅜" chuck. Saws 1¾" wood. Mounted on separate base with motor. Height 30". Weight 31 lbs. Top 10" x 12" easily removed. All metal construction. Easily driven by ¼ to 1/3 H. P. motor. Especially suited for Print Shops, Laboratories, Shipping Depts., Printers, Cabinet and Pattern Makers, Furniture Repairmen, etc. Machine sold with a money-back guarantee.

Our line includes bench jointers, bench band saws, bench drills, ½ to ¾ H. P. Ball-Bearing motors, and motor driven saws.

Write for descriptive literature and prices on Boice Pony Bench Machine and the above Boice-Built Bench Machines and Motors

W. B. & J. E. Boice 1730 Norwood Av. Dept. P. S. 3 **Toledo,**

Profit by His Experience

Let the seasoned experience of a veteran guide your selection of tools.

Most Master Mechanics endorse NICHOLSON Files because they have always used them. They know that perfection of finish is impossible with cheaper, lower-grade files. That because of ready-sharpness, finer temper, greater uniformity and endurance, NICHOLSON Files save precious time and expensive materials in their shops.

Let the other fellow get the experience---and profit by it whenever you can.

Every good Hardware Dealer carries a complete assortment of NICHOLSON Files and rasps. And most dealers are competent to advise you as to the sizes, shapes and cuts you need.

NICHOLSON FILE CO.
Providence, R. I., U. S. A.

NICHOLSON
U.S.A.
(TRADE MARK)

NICHOLSON FILES
~a File for Every Purpose

No. 1555

In the Out-of-the way Places

No. 1530

Where you are cramped for working space, "Yankee" Tools perform easily, quickly, accurately. The "Yankee" Ratchet saves time and labor. The

"YANKEE"
Ratchet Breast Drill
No. 1555

illustrated above, cuts continuously when the crank is moved only an inch either way. The "Yankee" Double Ratchet makes this possible. Fingertouch changes adjustment to Right—or Left-hand Ratchet. Plain Drill or gears locked. Two speeds, changeable without removing drill from work.

No. 1540

Some other "YANKEE" Tools

Ratchet Screw-drivers	Ratchet Hand Drills
Spiral Ratchet Screw-drivers	Chain Drills
Automatic Drills	Bench Drills

Dealers Everywhere Sell "YANKEE" Tools

TOOL BOOK Mailed Free

Illustrates and describes all the clever "Yankee" time and labor-saving tools.

North Bros. Mfg. Co.,
Philadelphia, U. S. A.

"YANKEE" TOOLS
Make Better Mechanics

Simply Made Combination Bench Saw Saves Handwork in Small Shops

By Frank N. Coakley

THIS combination bench saw, boring and molding machine is one of the most useful machines for the home workshop or any small woodworking shop in which standard woodworking machines are not available.

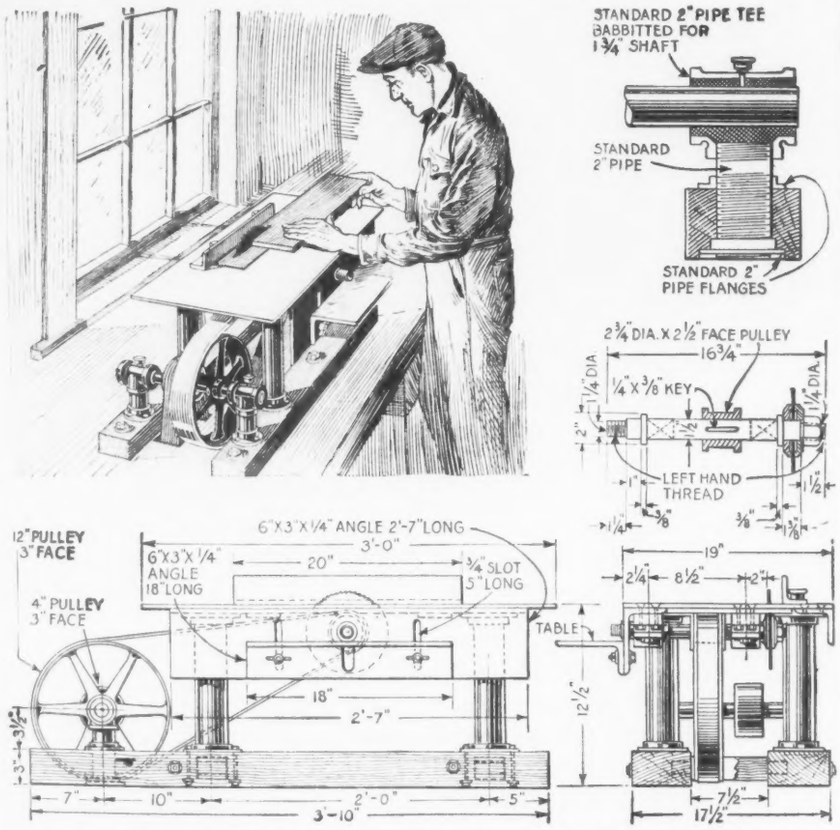
The top plate is a piece of ¼-in. plate 19 in. wide and 3 ft. long, with a slot cut in it 6 in. wider than the saw to allow the saw to be removed from the mandrel for sharpening or replacing. This slot should be made about 18 in. long and a piece of quartered oak placed in it, the wood being held with bolts to two flat pieces under the table.

The mandrel, which is fully detailed, is securely held in place by two bearings of any standard commercial design. All the parts that are fastened to the top plate are held by countersunk bolts. The top plate, of course, must be well finished and perfectly smooth. The gage plate or guide angle is held in place by two ¾-in. tightening screws, which are allowed to slide in two slots in the top plate.

A 3 by 6 by ¼ in. angle is fastened to the under side of the top plate. This angle is provided with a 3-in. hole in proper location to allow the end of the mandrel to pass through, and it also is slotted so that the table for the boring and molding side of the machine may be lowered or raised as necessary. The table angle is slotted so as to pass the mandrel. This allows a cutter head to be used to make moldings, the cutting head being under the table angle. When boring a hole, the table is lowered to the position shown and a standard chuck used to hold the bit.

Standard 2½-in. pipe is used to form the supports. These are fastened to oval floor flanges, which are securely bolted to two pine or oak pieces 3 by 5 in. by 3 ft. 10 in. long. These wooden pieces are connected by two cross members, as indicated.

The saw mandrel is driven by a countershaft, which is made and held in place as shown in the detail in the upper right-hand corner of the accompanying illustration, 2-in. standard cast-iron tees being babbitted to form the bearings. A 2-in. belt is used to drive the saw from the countershaft. The saw, which is 7 in. in diameter, should be run at between 1500 and 1800 revolutions a minute.



The completed saw driven by a motor beneath the bench, the side and end views showing adjustable table for boring and molding, and details of the mandrel and countershaft bearings

Hub Cap Provides Emergency Grease for the Car

OWNERS of cars should remember when a bearing on the car runs dry, due to lack of grease in a grease-cup, that the hub-caps of the front wheels carry an excess of grease with which these dry bearings can be lubricated, and this is better than running without grease.

Tycos

Temperature Control

THE SIXTH SENSE OF INDUSTRY

EVERY tick of your watch is a tribute to "the sixth sense of industry."

In the manufacturing of fine watches—whether the handsomely engraved case or the delicate hair-spring—heat is used. And whenever heat is used in a manufacturing process *Tycos* Temperature Instruments supply that "sixth sense" necessary to absolute uniformity of products that are manufactured on a big production basis.

Manufacturers of paints, furniture, rubber goods, metal ware, food products and all other products that go through heating processes in their manufacture, need in their plants the sixth sense of industry—*Tycos* Instruments for indicating, recording, and controlling Temperature.

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Tycos Engineers have effected substantial economy for manufacturers in every line of industry by applying the *Tycos* "sixth sense." Whatever your problem in the indicating, recording or controlling of heat there is a *Tycos* Instrument to serve you. Write us for literature on any instrument, or type of instrument, and it will be sent promptly. Or, if you prefer, our engineers will consult with you on the application of the *Tycos* Sixth Sense in your plant.

Tycos in the Home

Tycos *Office Thermometers*
An aid in promoting human efficiency.

Tycos *Bath Thermometers*
To enable you to get the most good from your bath.

Tycos *Home Set*
Bake Oven Thermometer. Candy Thermometer. Sugar Meter. The secret of accurate results in cooking.

Tycos *Wall Thermometers*
To help you maintain a temperature in your house conducive to good health.

Tycos *Quality Compasses*
To show you the right way in unfamiliar country.

Tycos *Stormoguide*
Forecasts the weather twenty-four hours ahead with dependable accuracy.

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A necessity in every home.

Tycos *Hygrometer*
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

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The SIX SENSES
√ *Hearing*
Tasting
Seeing
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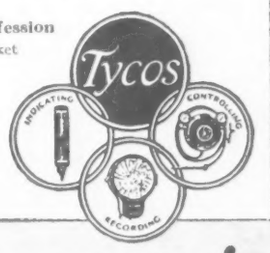
and
Tycos Temperature Control



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Tycos **BUILDING**
TORONTO

Taylor Instrument Companies
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ROCHESTER, N. Y., U. S. A.

Tycos Temperature Instruments
INDICATING · RECORDING · CONTROLLING

Uncle Bill *or* School-boy Bob

Whether for Uncle Bill's automobile or School-boy Bob's radio—eventually a part of the home equipment will be a Tungar, the battery charger which works from the house current.

When you get a Tungar for radio remember your auto battery too. It provides the added energy that every storage battery needs to make it give abundant service.

Sold by Electrical, Auto-accessory and Radio dealers.

Tungar is one of the many scientific achievements contributed by the G-E Research Laboratories toward the wonderful development of electricity in America.

Tungar Battery Charger operates on Alternating Current. Prices, east of the Rockies (60 cycle Outfits)—2 ampere complete, $18.00; 5 ampere complete, $28.00. Special attachment for charging 12 or 24 cell "B" Storage Battery $3.00. Special attachment for charging 2 or 4 volt "A" Storage Battery $1.25. Both attachments fit either Tungar.

Tungar
BATTERY CHARGER

Tungar—a registered trade mark—is found only on the genuine. Look for it on the name plate.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

GENERAL ELECTRIC

48E-2

21 Jewel Burlington—$1 Down

Used on nearly every vessel in the U. S. Navy. 21 Ruby and Sapphire jewels. 25 year Gold Strata case. Only $1 down. Balance in easy payments. Send for free book TODAY!

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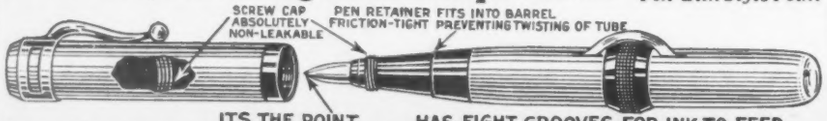
AMERICAN MOTOR CYCLE CO.
Dept. 326 2047 W. Chicago Ave. CHICAGO

Sells for $1.25. Agent's Sample 65c.! *New Self-Filling Bamboo Fountain Pen with Stylo Point*

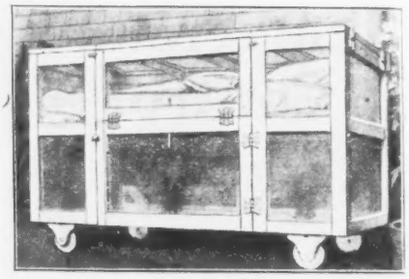

SCREW CAP ABSOLUTELY NON-LEAKABLE
PEN RETAINER FITS INTO BARREL FRICTION-TIGHT PREVENTING TWISTING OF TUBE
ITS THE POINT.
HAS EIGHT GROOVES FOR INK TO FEED

Imported from Japan. **"It makes Carbon Copies." Guaranteed for 1 year. Hustlers Making $20 Daily!** Money refunded if you don't think it's the best pen you ever wrote with. Up to 150 per cent Profit. Send for quantity price list and distributing plans. F. SPORS & CO., 199 S. 4th St., Lesueur Center, Minnesota

Baby's Crib and Play Pen Built from Home Workshop Blueprint

ARE you making full use of the Home Workshop Blueprints? Many readers are and they are unanimous in their enthusiasm for the blueprint service.

To the home worker a good blueprint is like a mariner's chart. It gives him all the information he needs to carry a project to a successful conclusion—cutting list, assembly drawing, full-size details of important parts, the types of joints, and the method of applying hardware and fittings.



This crib was constructed by Charles C. Greenman with the aid of Home Workshop Blueprint No. 26

The baby's crib and play pen illustrated was made from Blueprint No. 26 by Charles C. Greenman, of Bedford, Halifax Co., Nova Scotia, Canada. He says: "I hope you will continue issuing these prints as they certainly are great. I have had several and expect to start the kitchen cabinet table in a few days' time."

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York.

GENTLEMEN:

Send me the blueprint, or blueprints, I have checked below, for which I inclose.....cents in stamps or coin:

No.	Title	Price	
1.	Sewing Table	25c	☐
2.	Smoking Cabinet	25c	☐
3.	Book Trough End Table	25c	☐
5.	Kitchen Cabinet	25c	☐
6.	V. T. Radio Receiving Set	25c	☐
8.	Shaving Cabinet	25c	☐
9.	Arbor with Gate and Seats	25c	☐
10.	Porch Swing	25c	☐
11.	Bench and Tilt-Top Table	25c	☐
12.	Electric Washing Machine	25c	☐
13.	Tea Wagon	25c	☐
14.	Toy Train, Horse, and House	25c	☐
15.	Home Workshop Bench	25c	☐
16.	Inlaid Radio Cabinet	25c	☐
17.	Cedar and Mahogany Chest	25c	☐
18.	Telephone Table and Stool	25c	☐
19.	Grandfather's Clock	25c	☐
20.	Flat Top Desk	25c	☐
21.	Colonial Writing Desk	25c	☐
22.	Girl's Cabinet and Desk	25c	☐
23.	Pergola Garage	25c	☐
24.	Gateleg Table	25c	☐
25.	Sailing Outfit for Canoe	25c	☐
26.	Baby's Crib and Play Pen	25c	☐
27.	Kitchen Cabinet Work Table	25c	☐
28.	Pullman Play Table	25c	☐
29.	Toy Tea Cart, Garage, etc.	25c	☐
30.	Tool Cabinet, Bench Hook, etc.	25c	☐
31.	Priscilla Sewing Cabinets	25c	☐
32.	Chinese Game Table	25c	☐

Name .....
(Please print)
Street .....
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SHALER

5 Minute Vulcanizer

VULCANIZE *First —and Make it Last*

Rubber must be *heat-vulcanized* in order to obtain a permanent "weld" that lasts, and makes the punctured tube as good as new.

A Shaler repair cannot loosen or come off, because the repair is permanently *vulcanized* to the tube so that it is not affected by the heat and friction of driving.

It's easier than "sticking on" patches—quicker than changing tubes. It makes a strong, durable repair that flexes perfectly with the tube—and will not come off.

Over two million motorists use the Shaler and recommend it to their friends as a guarantee against puncture troubles. It saves time, prevents delays, gives longer mileage and pays for itself many times over.

All Auto Supply Dealers Sell It

Your Auto Supply Dealer has the Shaler 5-Minute Vulcanizer in stock, probably in his window. Stop in and get one for your car today.

C. A. SHALER CO., 2100 Fourth Street, Waupun, Wis.

Complete Outfit Only $1.50

including nickel-plated Vulcanizer 12 Patch-&-Heat Units (6 round for punctures and 6 oblong for cuts.) Extra Patch-&-Heat Units cost only 75 cents a dozen. Slightly higher in Canada and far west.

"Here's the panel I want"

The panel is the "front door" of your radio set. The selection of the panel is an important step. You want a good-looking panel. And you want a panel that has high dielectric strength.

Your Celoron panel comes wrapped in a dust-proof glassine envelope. Dust and grit cannot scratch it. Human hands cannot leave greasy finger prints on it.

Because of its high dielectric strength, Celoron is approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps.

Celoron radio panels are finished in black, oak, and mahogany. They come ready to use in these standard sizes:

1...6 x 7 x 3/16 — 5... 7 x 18 x 3/16
2...7 x 9 x 3/16 — 6... 7 x 21 x 3/16
3...7 x 12 x 3/16 — 7... 7 x 24 x 3/16
4...7 x 14 x 3/16 — 8...12 x 18 x 3/16
9...7 x 26 x 3/16

Other sizes are cut to order from sheet Celoron. *Ask your dealer.*

An interesting booklet for the radio set builder is *"Getting the Right Hook-up."* This booklet is sent free upon request.

To radio dealers: Send for special dealer price list showing standard assortments

Diamond State Fibre Company

BRIDGEPORT (near Philadelphia) PENNSYLVANIA

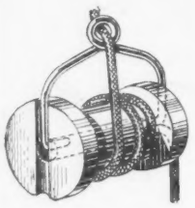
Branches in Principal Cities
Toronto, Canada—London, England

CONDENSITE CELORON STANDARD RADIO PANEL

Spool Provides Adjustment for Electric Droplight

THIS spool adjuster for droplights is a simple but not unsightly device that will line up the lamp cord quickly and effectively.

At the inner edge of one rim of a large spool a hole is bored through to the central hole, and through this is passed the lamp cord. At the other rim cut a groove in the outer surface, as indicated. This engages one arm of the wire hanger. The edges of the groove should be rounded to permit the spool to be wound either way. At the same time, the groove and wire act together as a sort of ratchet and prevent the spool from unwinding by itself. The cord extending from the spool to the light always remains the same length.—ROLAND B. CUTLER.



Spool and wire sling

Readers Report Fine Results with Unique One-Tube Radio Set

MANY letters have been received from readers telling of the exceptional results they have obtained with receiving sets built in accordance with the constructional article, "One-Tube Radio Set Operates Loudspeaker," in the January issue of POPULAR SCIENCE MONTHLY.

C. B. Cooper, M.D., of Grandview, Tex., writes:

I copied your hook-up in the January issue and finished it at 12 midnight, December 10, 1923. Tuned in KPO, San Francisco (1400 miles), so loud on head set that I put it on a standard loudspeaker with one stage of audio-frequency amplification. This shows that the hook-up discounts distance wonderfully.

George A. Allen, Miami, Fla.:

I bought POPULAR SCIENCE MONTHLY on Saturday and by Sunday evening had the one-tube set going. At once got WOC (Davenport, Ia.), 1200 miles away, which I never heard before on two standard five-tube sets I have used. Also got WBAP, WRC, WEAF, WOR (Newark, N. J.), WJZ, WMC, WOS, and WWJ (the two latter stations I never had heard before). These were not just audible, but strong enough to be entertaining.

David Whyte, Poughkeepsie, N. Y.:

I have just completed the one-tube receiving set according to your January article and am very pleased to say that I have found this set more than satisfactory and very selective. I should be glad to recommend this hook-up to any one who wishes to build a one-tube set cheaply.

C. S. Conrad, Lima, Ohio:

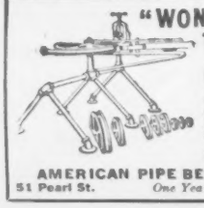
I have tried several hook-ups for radio and in the last issue (January) of POPULAR SCIENCE MONTHLY found what I wanted. The stations received in one evening are as follows: KDKA, WGR, WOR, WLW, WOS, WRC, WGY, WDAP, WBAY, WOC, WBAD, KOB (State College, New Mexico), WFAA, WBAP—not so bad for the second time the outfit was in operation.

Any one who overlooked this noteworthy article in the January number can obtain that issue from the Circulation Department, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York, for 25 cents as long as there are copies left.

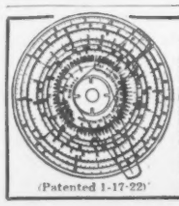
RED lead is being used effectively for priming exterior woodwork, especially such woods as Southern pine, cypress, and spruce, which sometimes are full of sap. When the orange color is objectionable, it is covered by two coats of white-lead paint.

GERSTNER CASES are GOOD *Cases*
Machinists, Toolmakers and other particular mechanics appreciate their splendid qualities. Catalog free. Write for it to-day.
H. GERSTNER & SONS
503 Columbia St., Dayton, O.

One Charger for All Batteries
Charges 2-volt peanut tube batteries, 6-volt A Batteries, 6- and 12-volt automobile batteries, and 1 to 4 B Batteries. It's the
Valley Type ABC Battery Charger
VALLEY ELECTRIC CO., St. Louis, Mo.



"WONDER" COLD PIPE, TUBING & BAR BENDERS
Standard of the World
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe $1.00
Send for Catalogue.
AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. *One Year to Pay.* Boston, Mass.



The Midget *"Five-in-One"* Slide Rule
is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with Instructions, $1.50. Leather Case 50c extra. Catalogue Free.
(Patented 1-17-22)
Gilson Slide Rule Co., Niles, Mich.

TRADE MARK Red Devil Tools "Red Devil" THE WORLD'S STANDARD Better Made

"Red Devil" Tools

Make Your Everyday Repair Jobs Easy

"Red Devil" Chain Drill, No. 2018 drills through metal as easily as an auger bit through wood. You take the tool to the work, instead of the work to the shop. It's automatic.

Price each, $4.80.

"Red Devil" Glass Cutter, No. 024—the most popular glazier's tool in the world. The hand honed cutting wheel cuts the glass clean, clear and sharp. It's economical to do the little jobs yourself with it.

Price each, 20c.

"Red Devil" Slip Joint Plier No. 850—an all-around practical tool with wire cutter, burner grip, and flat nose plier. Slip joint gives wide range to gripping jaw. About as useful a tool as any mechanic can own.

Price each, $1.30

"Red Devil" Hack Saw Frame No. 1048. Adjustable for 8 to 12 inch blades. Depth of cut 3¼ inches. The steel frame is strongly constructed.

Price each, $1.00.

THEY reduce difficult problems in the home, the office, the workshop—around the car, to surprisingly easy tasks. There is the right tool for the right job. There's no end to the number of useful things you can make and mend with them. They help you keep things in order—help you save. Forged of steel for strength.

The following are a few "Red Devil" Tools and their suggested uses:

Chain Drills:

for drilling iron, the engine cylinder, truck frame, angle irons, pipe, wagon tires, for brick, concrete, etc.

Glass Cutters:

for repairing windowpanes, glass sashes, greenhouses, for making passepartouts, table tops, glass trays, aquariums, etc.

Pliers:

for repairing radio sets, gas engines, motorcycles, automobiles, trucks, tractors, vacuum cleaners, sewing machines, guns, typewriters, toys, for amateur plumbing jobs, etc.

Hack Saw Frames and Blades:

for cutting sheet metal, pipe, tubing, cables, structural steel, etc.

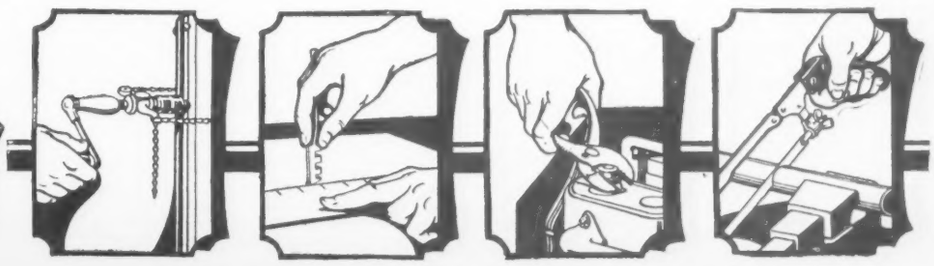
"Red Devil" Tools also comprise a complete line of Auger Bits, Screw Drivers, Snips, Wrenches, Cold Chisels, Bolt Cutters, etc. Be sure to look for the "Red Devil" trade mark on each and every tool. Your dealer has them in stock—if not, he can get them for you.

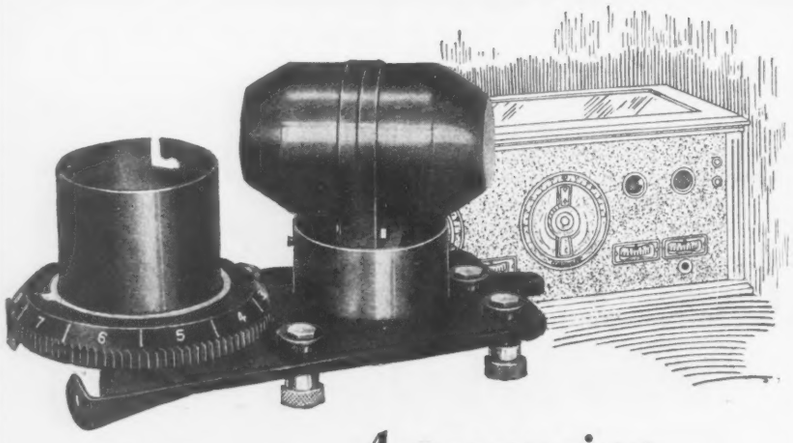
Send for the "Red Devil" Mechanic's tool booklet—a handy reference guide for users of good tools.

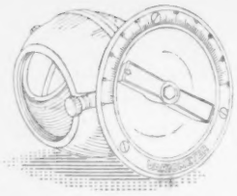
Smith & Hemenway Company, Inc.

Manufacturers of "Red Devil" Tools

264 Broadway New York





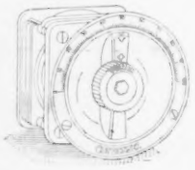


Announcing—

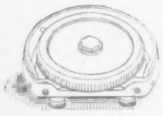
A New Radio Frequency Transformer

—in a combination unit, consisting of transformer, tube socket and rheostat.

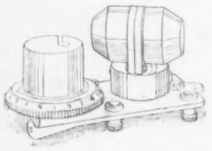
Especially designed for use in tuned radio frequency circuits—the most practical method of amplifying high (radio) frequency impulses.



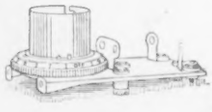
The trend toward radio frequency amplification is to be expected. Its advantages are many—long distance reception; the excellent results obtained with indoor aerials, and an entire absence of interference with neighboring receivers.



When incorporated in a tuned radio frequency circuit, this transformer amplifies efficiently at all wave lengths employed in present-day broadcasting.

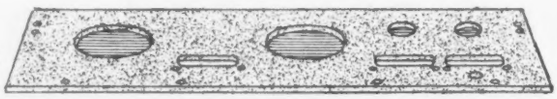


All Eisemann units are matched one to the other, not only in their electrical co-relation but also in appearance, and, when assembled, present a harmonious whole.



Complete instructions for wiring are given, and the individual not deeply versed in Radio can build a receiver with assurance of results.

Catalog sent on request



EISEMANN MAGNETO CORPORATION
WILLIAM N. SHAW, *President*
40 Thirty-Third Street Brooklyn, N. Y.

Chinese Game Table

(*Continued from page 81*)

1 7/16 by 2⅛ in. The eight end bins are pieces 1⅛ by 1 11/16 by 5 in., hollowed in the upper surface. The eight center bins are 1⅛ by 1 11/16 by 10 3/16 in. The 12 bin divisions are ¼ by 1⅛ by 1 9/16 in. The four filling pieces that form the inside partition between the bins and the playing surface of the table are 5/16 by 1 3/16 in. by 2 ft. 11⅛ in. They are notched at each corner (Fig. 3, page 83) so as to allow four small lids to be used for the four square corner compartments. These compartments, the construction of which is clearly shown in Fig. 3, are for holding the dice and other small objects.

The main table top or center board is glued up from pine or poplar ⅞ in. by 2 ft. 7 in. by 2 ft. 7 in. It is covered with cork, cork linoleum, or rubber ¼ in. thick, and with a piece of felt table cover 2 ft. 9 in. by 2 ft. 9 in. The cloth is turned over and tacked to the board base edges.

The whole top is simply dropped into place and fastened with screws from underneath the table frame. The ashtrays in this case are turned from 1¼ by 2½ by 2½ in. wood with glass inserts. Beside the hinges, four brass elbow brake braces or stays 10 in. long, and four silent caster domes 1 in. in diameter are needed.

Obtaining an Oriental Finish

One of the most effective finishes for the table is an Oriental black. This is obtained by giving one priming and one finishing coat of flat red paint, preferably vermilion coach color, but, in any event, a very brilliant red of fine quality. The second coat is smoothed with 00 sandpaper and then covered with one or two coats of rich black furniture enamel. The final coat is rubbed vigorously with FF powdered pumice-stone and rubbing oil, raw linseed oil, or sewing-machine oil. The enamel is rubbed hard so that the vermilion shines through in places and gives a warm underglow. The general tone is then one of an antique Oriental piece, black lacquered over red.

This type of table is also frequently finished in ivory black and occasionally in walnut or mahogany.

The shop drawings of this table, with full-size details of the essential construction and a completely itemized bill of materials or cutting list, are contained in Blueprint No. 32 of the Home Workshop series. This can be obtained for a nominal charge of 25 cents from the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

For the Woodworker

TWO practical designs for dining alcoves will appear in the April Home Workshop.

Among other articles scheduled for early publication is one by Edwin M. Love on time-saving tricks of the carpenter's trade for home workers, another by S. W. Blanchard, "'Habitant' Chairs, Built by Home Craftsmen," and a third on building a corner china closet.

We Want Agents at $50 to $90 a Week

New Invention—Just out. Needed in every home every day. Patented. Nothing else like it. Low priced—**Sells on sight.** Sharpens any kitchen knife, paring knife, carving knife, bread knife, or shears and scissors **in ten seconds.** Mechanical masterpiece. A child can use it. Just put knife in slot—turn crank—sharpens both sides at once automatically. **We want representatives at once**—men and women hustlers. Get this position where **profits start first day.**

No Experience Necessary—200% Profit

Make as much money next week as these men are making now. J. C. Lewis, of Kansas, says: **"I have sold one hundred sharpeners in four days."** Hobart Kerr, of Md., writes: "The women can hardly wait till they get them." Herbert Caln, of Ky., sold nine after supper. At the end of the first day, J.W. Gordon, of Pa., writes: "I sold two dozen and **I sold to every one I saw."** Wm. G. Hall, of N. J. says: "I think it is great. I sold six in about one-half hour. The machine is a mighty fine proposition. **I am a mechanic and I know what I am talking about." You can make this money. WRITE TODAY. TERRITORY FREE. Get busy at once.**

QUICKEDGE SHARPENER CO. 663 Sharpener Bldg. Jackson, Mich.

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TO experience the thrill of supreme radio enjoyment, add to your equipment a Magnavox Combination Set as here illustrated.

This instrument combines a Magnavox Electro-Dynamic Reproducer and Power Amplifier in one marvelous unit—with it you can reproduce those distant stations you have always wanted to hear.

The first trial will convince you that Magnavox Combination Sets are a notable contribution to the radio art.

For permanent radio satisfaction choose Magnavox.

Magnavox Reproducers: M1 (for dry battery sets); R2 and R3 (electro dynamic) . . $35 to $60

Magnavox Combination Sets: electro-dynamic Reproducer with one or two stages of amplification $59 to $85

Magnavox Power Amplifiers: may be had in one, two or three stage (audio-frequency) $27.50 to $75

Magnavox Products are for sale at good dealers everywhere. Write for catalogue.

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New York Office: 370 SEVENTH AVE.
Perkins Electric Limited: Toronto, Montreal, Winnipeg, *Canadian Distributors*

For Every Receiving Set there is a MAGNAVOX

Exit Variocoupler
Enter Erla Selectoformer

Combines Improved Properties of Coupler and Wavetrap

Again Erla contributes notably to radio advancement. Erla Selectoformer, replacing alike variocoupler and wavetrap, greatly increases volume and selectivity in radio receivers, at the same time reducing cost.

Selectoformer, as the name implies, operates simultaneously as a selector and radio frequency transformer, picking off of the antenna the one wavelength desired and amplifying it to normal strength.

Thus is avoided the interference common to receivers that depend for selectivity upon tuning the coarse antenna system. Also, because of the amplification brought to bear, there is eliminated the loss of energy encountered in wavetraps of conventional type.

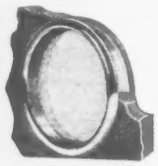
With Selectoformer, distant signals come in loud and clear, even with powerful local broadcasting in progress. Tone quality, likewise, is greatly improved, through reduction of static and other disturbances.

Control of the Selectoformer is effected through the 23-plate condenser already built into most receiving units. Installation is a matter of moments only.

For complete details regarding this and other Erla improvements, including latest reflex circuits, ask your dealer for Erla Bulletin No. 20, distributed gratis; or write, giving your dealer's name.

Superior worth of Erla audio transformers, shown in their exclusive ability to amplify three stages without distortion, improves any set. $5

Erla condensers alone carry a certificate of accuracy on their labels. Look for the words "Tested Capacity" when buying. 35c to 75c ea.



Patented telescoping rim of Erla bezels fits any $\frac{1}{8}$" to $\frac{1}{4}$" panel, neatly screening openings required for tube ventilation. Nickel or enamel, 20c

Reliable and clear reception is assured through the Erla fixed crystal rectifier, requiring no adjustment and lasting indefinitely. List $1

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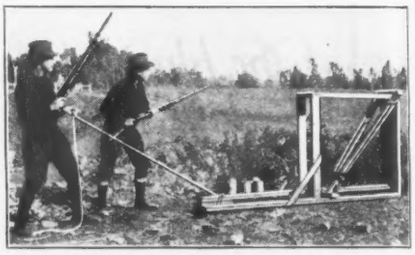
ERLA

Trap Shooting with Homemade Catapult and Tin "Birds"

By John Edwin Hogg

NEXT to game hunting, shotgun shooting at clay birds, or other forms of flying targets, offers the most alluring sport with the gun. Clay-bird shooting, however, is denied to many sportsmen because of the expense. In an effort to reduce the cost, the writer recently developed the catapult illustrated, which hurls tin cans aloft for use as shotgun targets. Only $3.70 worth of lumber and hardware was used to build the catapult.

It consists of a wooden frame stoutly reinforced with metal cleats, and a wooden hurling arm, to which motive power is supplied by stretching two discarded motor tubes. Light and compact, the catapult may be hauled to and from the shooting grounds on the runningboard of a small roadster.



Shooting at the tinware birds (above); ready to spring the catapult (below)

On the shooting grounds it is necessary to have on hand only a supply of old tin cans. The hurling arm, which is pressed downward to bring the inner tubes under tension, is latched and the cans are placed on the arm. A cord fastened to the latch frees the hurling arm at the will of the shooter. The arm flies up, strikes the top of the frame, and the tinware keeps on going—usually about 100 ft. in the air.

The shooting grounds chosen for experimentation with the catapult is near the city dumping ground at Alhambra, Calif., where there is an unlimited supply of tinware to be shot at. Once built, and transported to the scene of activities, the operation of the catapult costs nothing. It will throw tin cans all day to provide a most excellent and inexpensive form of shotgun target shooting.

Keeping an Auto Tuned Up

EVERY motorist will find many labor- and money-saving suggestions in a new series of articles by Ray F. Kuns, the first of which is scheduled for early publication in the Home Workshop Department. His first article tells how to eliminate spark-plug trouble and he cites as an example a motorist who makes a set of plugs last at least 28,000 miles.

Deafness

Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

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A Radio Statement to the Public

The Meaning of Coordinated Scientific Research

KEEPING its pledge to the public, the Radio Corporation of America has concentrated its vast research and engineering forces upon the solution of certain fundamental problems facing the art—problems which have become more apparent as broadcasting stations and radio receivers multiply.

The phenomenal expansion of the radio industry, and the universal and ever-increasing appeal of radio represent an outstanding development of the present century—for this industry has grown from infancy to maturity in a space of but two years.

• • •

Briefly stated, there is today a necessity for

—*A radio receiver providing super-selectivity*—the ability to select the station you want—whether or not local stations operate. A selectivity which goes to the theoretical limits of the science.

—*Super-sensitiveness*—meaning volume from distant stations—along with selectivity.

—*Improved acoustics*—more faithful reproduction of broadcasted voice and music than has ever been possible before.

—*"Non-radiating" receivers*—a new development, a type of receiver which, no matter how handled, will not interfere with your neighbor's enjoyment.

—*More simplified operation*—a super-receiver requiring no technical skill, thus making the greatest achievements of entertainment immediately available to all members of the family.

—*A receiver for the apartment house* and populated districts, requiring neither aerial nor ground connection.

—*Another type of improved receiver for the suburban districts*, equally capable to that above, for use where the erection of an aerial presents no problem.

• • •

Painstaking search in quest of these ideals has led to new discoveries, setting new standards of excellence and performance—discoveries which have established:

First—that improved acoustics are possible—a matter of scientific research and not of haphazard design—for truly melodious reception.

Second—that dry battery operated sets can be so designed as to give both *volume* and distance.

Third—that the regenerative receiver is susceptible to marked improvement providing selectivity, sensitiveness and simplicity of operation hitherto deemed impossible of accomplishment.

Fourth—that the Super-Heterodyne—the hitherto complicated device requiring engineering skill to operate—could be vastly improved—improved in sensitiveness and selectivity—and simplified so that the very novice and the layman could enter new regions of entertainment and delight.

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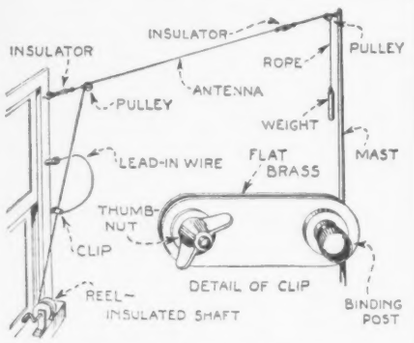
Aerial with Length Adjustment Improves Radio Reception

By L. B. Robbins

FOR maximum efficiency in radio reception, the antenna must be the right length. Some radio fans have several aerials of different lengths, but this is not necessary if the antenna is adjustable.

Erect the masts at the greatest possible distance apart, say 200 ft. The farther mast from the set should have a fixed pulley at its peak; the nearer mast an insulated pulley fastened by means of a short rope. Provide a 225-ft. antenna



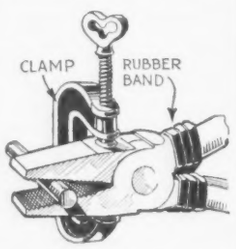
By reeling in or letting out the aerial, the utmost efficiency is insured

and fasten the farther end to an insulator, which is fastened, in turn, to a rope that runs down through the fixed pulley and ends in a weight.

The near end of the antenna is then run down through the suspended pulley and fastened to a reel with an insulated shaft and drum. When the reel is wound up, the antenna is pulled toward the nearer mast and thus shortened. When the reel is unwound, the weight carries the antenna up again and stretches its length between the masts.

The vertical part of the wire acts as part of the lead in. A clip can be clamped on this lead-in wire at the most convenient point. Any kind of clip can be used, but one that will be positive and will stand the wear and tear is illustrated.

Extending Usefulness of Pliers



WHEN using ordinary pliers for handling a number of small things, they usually may be made to open automatically by winding a rubber band around the handles, close up to the joint. This will not prevent their closing.

To use a pair of pliers as a small vise, hold the jaws together with a small C clamp, such as may be obtained at hardware stores for about 10 cents.—E. A. M.

A GOOD soldering flux can be made by dissolving powdered rosin in alcohol and adding a little glycerin to prevent drying or caking. This may be used with thin wire-solder and a well-tinned soldering copper to produce perfect electrical connections.

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IT'S so easy now—assemble any radio hook-up in half the time—make connections leakproof as soldering with

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Fit all radio nuts. Hollow stem goes over projecting screws—hex socket gets full grip and protects nut—ebonized handle for comfortable leverage—cinch to reach difficult places. All sizes from 3/16 to ½ inch.

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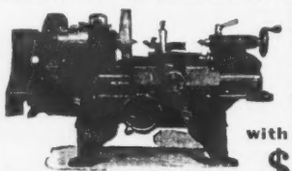

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and we will send you free this 52 page catalogue of radio sets and parts. It also contains explanation of radio terms, map and list of broadcasting stations and much radio information, including an explanation of successful hook-ups and circuits.

You will be amazed at the low prices Ward's quote. A complete tube set having a range of 500 miles and more, including tube, head set, batteries, and antenna equipment, as low as $23.50.

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The Oldest Mail Order House is Today the Most Progressive

"What a whale of a difference just a few cents make!"

— *all the difference* between just an ordinary cigarette and—FATIMA, the most skillful blend in cigarette history.

Sturdy Flower Box and Stand Hold Indoor Garden

By Kenneth R. LaVoy

THE plant stand and flower box illustrated can be used for ferns, potted plants, or water-growing bulbs that will keep a bit of summer in the house all year round.

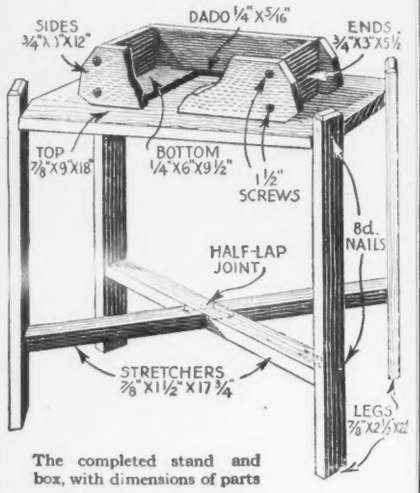
The materials needed for the stand are:

1 top, ⅞ by 9 by 18 in.
4 legs, ⅞ by 2½ by 22 in.
2 stretchers, ⅞ by 1½ by 17¾ in.
Eightpenny finishing nails

For the flower box:

2 sides, ¾ by 3 by 12 in.
2 ends, ¾ by 3 by 5½ in.
1 bottom, panel stock, ¼ by 6 by 9½ in.
8 screws, 1½ in. No. 10, blue head
Bread tin to fit box
Putty, glue, stain, or paint and enamel

To build the plant stand, first prepare the legs and top. Then lay off on the top



The completed stand and box, with dimensions of parts

light penciled lines to represent the diagonal stretchers. Get the stretchers ready, allowing 1 in. extra length for fitting the ends. Place one stretcher on the top along the lines already laid out and mark the cross-lap joint from the lines indicating the other stretcher. Next, cut the ends to correspond in length with the top. Do the same with the other stretcher and cut the half-lap in both. If done carefully, the pieces will fit together.

In assembling, fasten the legs first to the top and then to the stretchers. The half-lap joint may be fastened with glue or with a ¾-in. bright head screw from the under side. Use eightpenny finishing nails for assembling and set the heads so that the holes can be plugged with putty.

The dado on the sides and ends of the flower box is made with a combination plane or with a chisel. It should be at least 5/16 in. deep to allow for the expansion of the bottom. First place one end and side together, put the bottom in position, and fasten the second side, leaving the other end until the last.

If the work is to be stained, hard wood should be used, but any soft wood will do for paint and enamel. A pleasing finish is to enamel both stand and box and then apply a simple stencil design to the sides of the box and on each leg of the stand.

A bread tin makes a cheap and watertight lining, and can easily be moved, when necessary, to replace the flowers.

Home Protection
with an
ASTRA Automatic
will cost little

Nearly every man wants a gun in the house—he feels better able to protect his family. We are able to offer these Genuine Astra guns at special prices because we bought before recent tariff raises became effective. Really fine guns, beautifully finished, hard hitting. Use standard ammunition. Order direct from U. S. importers.

$7.75 25 calibre—7 shot—C. O. Q. Automatic.
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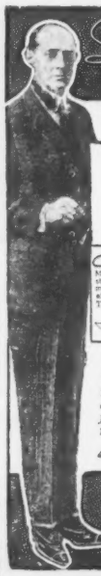

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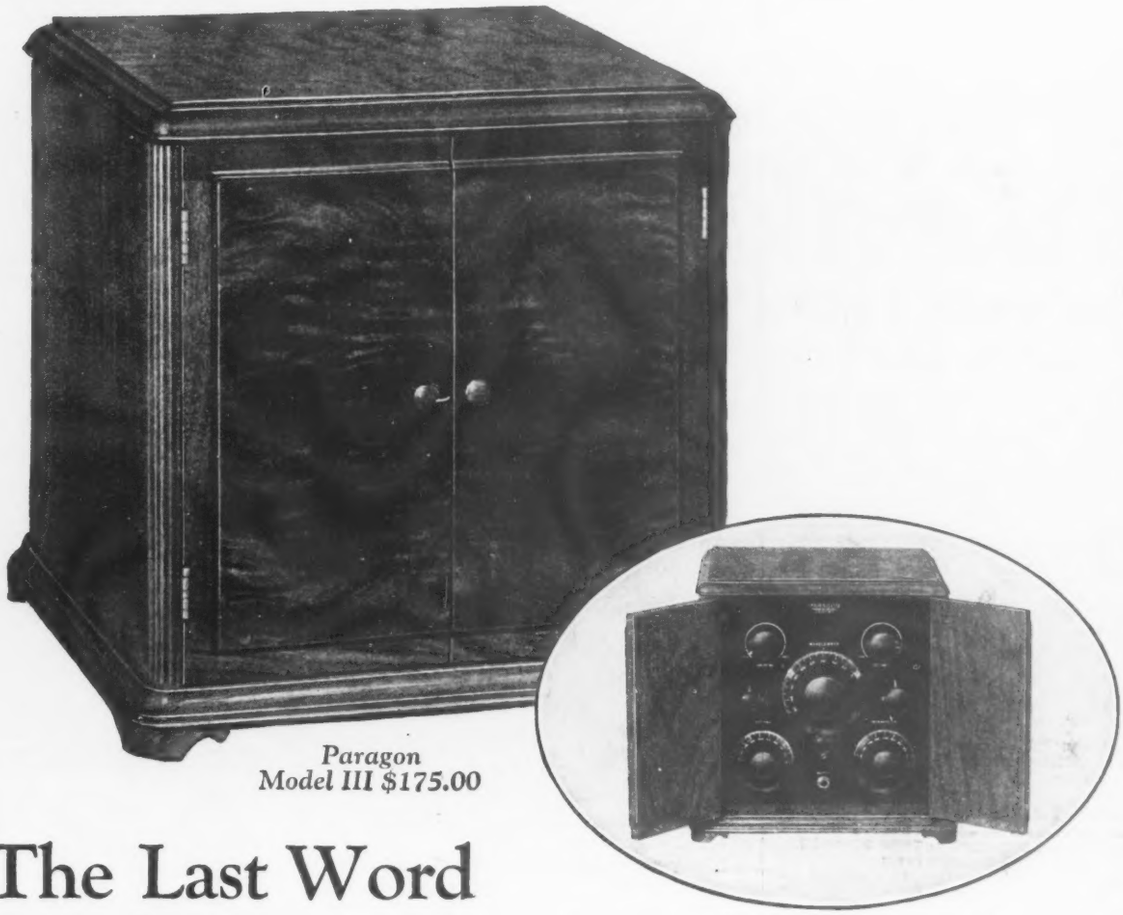

Paragon
Model III $175.00

The Last Word In a Paragon Receiver for the Home

At last—a radio set that not only harmonizes with your furniture but adds to the attractiveness of any room in which it is placed. And not an ordinary radio set but a PARAGON.

Paragon Receivers are famous for the long distance records they hold which include the reception of the first trans-continental amateur message and the first trans-Atlantic message. It is a Paragon that keeps the world in touch with the MacMillan Expedition frozen in north of Greenland.

Paragon Receivers, because of their superior selectivity and sensitivity, are equally famous for the ease with which they can be operated and the clear results obtainable.

Now comes the latest Paragon, the Model III, pictured above, with all the advantages of the other models but housed in a mahogany or burled walnut cabinet which is a work of art.

In appearance, the Paragon Model III Receiver now matches up in every way to the perfection of the instrument itself.

Illustrated Bulletins of Paragon Radio Products are yours for the asking.

Dealers: We believe in the proper distribution of Paragon Radio Products. Our Exclusive Distributors are particularly interested in territorially protected dealers, who will concentrate, solicit and serve the consumer in the sale of Paragon Radio Receivers. If interested, write us for details.

ADAMS-MORGAN CO., - 18 Alvin Avenue - Upper Montclair, N. J.

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

"They've tripled your salary, dear"

"I TELL you, Tom, it was a lucky day for both of us when you sent in that I. C. S. coupon. You'd never be where you are to-day if you hadn't decided to study in spare time just when you did."

Spare-time study with the I. C. S. is winning promotions for thousands of men and bringing happiness to thousands of homes all over the world. In offices, shops, stores, mines, mills and on railroads, I. C. S. trained men are stepping up to big jobs, over the heads of older men, past those whose only qualification is long service. There is a job ahead of YOU. Some man is going to be picked for it. The boss can't take chances. He is going to choose a trained man with sound, practical knowledge of the work.

Get busy right now and put yourself in line for that promotion. You can do it in spare time in your own home through the International Correspondence Schools, just as thousands of other men and women have done.

The first step they took was to mark and mail this coupon. Make *your* start the same way—and make it right now.

MAIL THE COUPON TO-DAY!

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7680-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING COURSES

☐ Business Management	☐ Salesmanship
☐ Industrial Management	☐ Advertising
☐ Personnel Organization	☐ Better Letters
☐ Traffic Management	☐ Show Card Lettering
☐ Business Law	☐ Stenography and Typing
☐ Banking and Banking Law	☐ Business English
☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
☐ Private Secretary	☐ High School Subjects
☐ Spanish ☐ French	☐ Illustrating

TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineering	☐ Architect
☐ Electric Lighting	☐ Blue Print Reading
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

Name.....
Street Address..... 11-21-23
City..... State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

Clear Your Skin!

Your Skin Can Be Quickly Cleared of Pimples, Blackheads, Acne Eruptions on the face or body, Barbers Itch, Eczema, Enlarged Pores and Oily or Shiny Skin,

FREE Write today for my FREE BOOKLET, "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted 15 years.

$1000 Cash says I can clear your skin of the above blemishes.

E. S. GIVENS, 153 Chemical Bldg., Kansas City, Mo.

DRESS UP YOUR CAR

$3.85 AND UP CUSTOM MADE

A seedy looking top spoils its appearance. Get a Liberty Custom Made Top. It's fun putting it on, simple directions furnished. Save a big labor bill. We are manufacturers of tops, side curtains and seat covers, for any make or model car. Amazing values. Special proposition for Fords, Chevrolets, Dodges and Maxwells. Write today for big money saving catalog.

LIBERTY TOP & TIRE CO., Dept. E-8 Cincinnati, Ohio

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THE home workshop is not complete if a soldering iron is lacking. It is, therefore, important for the amateur mechanic to understand the uses of a few of the more common kinds of solder.

The strength of a soldered joint is only as strong as the solder used. For general work, a solder consisting of 1 part of lead and 1 part of tin is excellent. More lead can be used, but too much should not be employed.

Soldering wire connection with a blowpipe

An ordinary hard solder, which is fairly easy running and makes a strong joint, although it is rather red in color, consists of 70 parts of copper, 22 parts of zinc, and 8 of tin. A solder for iron, steel, and the bronzes consists of 53 parts of copper, 43 parts of zinc, 1 part of tin and a trace of lead.

Many radio enthusiasts still use crystal detectors. Since unmounted crystals are cheaper and offer a wider selection for sensitivity than mounted crystals, it pays to provide a low melting alloy suitable for mounting a crystal in a detector cup. Such an alloy consists of 4 parts (by weight) of bismuth, 2 parts of lead, 1 part of tin, and 1 part of cadmium. These metals can be purchased in small quantities from any large chemical house.

Place the bismuth, the lowest melting metal, in an iron spoon and heat over an alcohol or other flame until melted. Then add the other metals one after the other. With few exceptions, the lowest melting metal is added first and, when this has melted, the next is put in.

Preparing a soft solder for radio work by melting easily fusible metals together, and casting the alloy in a mold of hard clay

If it is desired to cast the alloy or solder in bars, it can be done easily by pouring the melt into a mold of refractory substance. I use a block of good clay that was dried in a shaded spot for three

(*Continued on page 128*)

Those Saxophone Blues!

Drive away the blue devils, give your musical longing free expression, win new popularity with an "Inspiration" Saxophone!

***Inspiration* Leads the World!**

Easiest to learn! Acknowledged the finest, sweetest, easiest playing Saxophone made! Absolutely pure tone! No buzz or rasp! Easy action! Always in perfect tune! Guaranteed quality! Exceptionally beautiful finish!

Free Trial—Easy Terms!

Write for FREE Catalog describing "Inspiration" Saxophones — Cornets — Trombones — Trumpets—Mellophones, etc., etc. All equally supreme in tone and quality! Try your choice for week's FREE TRIAL in your own home. Easy monthly payments. Write TODAY!

Dealers—Some choice territory still open—Write

LYON & HEALY INC.
64-90 Jackson Blvd. CHICAGO

We Teach COMMERCIAL ART

Meyer Both Company, the largest Commercial Art Organization in the World offers you an unusual opportunity for practical training, based upon twenty-three years of success. This nationally known organization each year produces and sells to advertisers over 15,000 commercial drawings. Meyer Both instruction is the difference between successful fact and experimental theory This well paid profession equally open to men and women. Home study instruction.

Get Facts Before You Enroll in Any School

Ask the Advertising Manager of the leading newspapers in your city, anywhere in the United States, Canada, England or Australia about the Meyer Both Company—let them tell you about us. Write for our illustrated book telling about the success of our students—for one-half the cost of mailing—four cents in stamps.

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Note—To Art and Engraving Firms: Secure practical artists among our graduates. Write us.

Special 5 Size Tap and Die Set, Only $3.00

DIRECT FROM THE FACTORY TO YOU!

Our No. 12 Automobile Set furnished in our highly finished chest box contains 5 **each** taps and dies (1-4, 5-16, 3-8, 7-16, and 1-2" the S. A. E. thread, 1 die stock, and one tap and reamer wrench.

Our No. 11 Set is the same as No. 12 except that the thread is U. S. instead of S.A.E. You are purchasing a splendid set at a very low figure

Send us your order at once and be one of our many satisfied customers

Let us also send you one of our circulars illustrating our line of Handy Tools.

WORCESTER STEEL PRODUCTS CO.
Dept. M. 29 Union Street, Worcester, Mass., U. S. A.

Coto

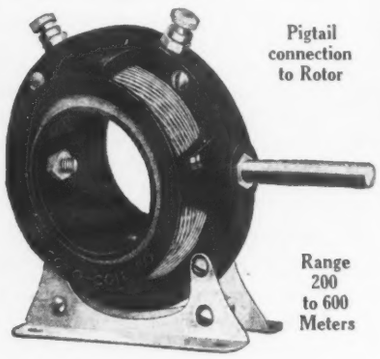
"Built First to Last"

Beginners, Experienced Amateurs and Experimenters Turn to Coto for Radio Parts

You can build from the very simplest radio set up to one with the latest refinements with Coto parts. And what is more fascinating than to try out the various circuits as they are published? And with Coto parts you know you will be getting the very best from these circuits. Learn the A. B. C. of radio—*"Always Buy Coto."*

Use All the Energy in Your Antenna

Don't waste it in the insulation losses of an inferior condenser. It's like pouring water in a sieve. The low losses of a Coto Condenser insure maximum signal strength. Use one and be convinced.



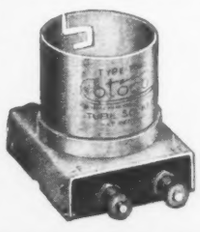
Pigtail connection to Rotor

Range 200 to 600 Meters

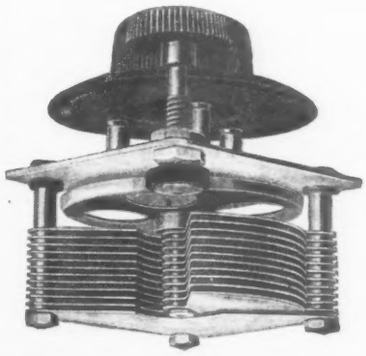
"So Much Better than Your Advertising Claimed"

These are the words of a pleased user of Coto Compact Moulded Variometer. He was surprised because of its wonderfully compact size (3¼ x 1¾ x 3¾ in.) to find it splendidly efficient over the broadcasting wave lengths 200 to 600 meters. Price $5. The Coto Moulded Variocoupler to match is just as fine, $5.50.

The Tube with Double Grip and Hard Rubber Insulation



Cotogrip means positive contact, and the best radio insulation prevents leakages **85c**



Coto Variable Air Condenser WITH VERNIER

There is just one bearing in this condenser and that is protected with hard rubber, the best known radio insulator. Plates are of SILVER PLATED copper, soldered rigidly in place for lasting efficiency. Complete with vernier adjustment and handsome dial. Type 3505, .0005 Mfd. $5. Type 3510, .001 Mfd. $6.

GUARANTEE!

Every piece of Coto Radio apparatus is Laboratory Tested before shipment. So we authorize dealers and jobbers to guarantee you absolute satisfaction.

COTO-COIL CO.

87 Willard Ave., Providence, R. I.

BRANCH OFFICES:

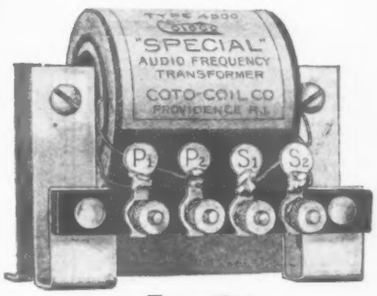
Los Angeles, 329 Union League Bldg.
Minneapolis, Geo. F. Darling, 705 Plymouth Bldg.
Atlanta, C. P. Atkinson, Atlanta Trust Co. Bldg.

CANADIAN DISTRIBUTOR:

PERKINS ELECTRIC CO., LTD.
MONTREAL, TORONTO, WINNIPEG

"Superior to Any Other Regardless of Price"

Mr. W. R. Reschke of Staten Island, New York, writes us,—"I am forced to write you this letter. I have been using your Coto Transformers in quite a number of sets and find them superior to any other transformer regardless of price. The results I get I cannot equal with other audio transformers, clear and plenty of amplification. Am using WD11, WD12 and U. V. 201. A tubes."



Type 4500

The 3 to 1 Ratio Audio Frequency Transformer Is Best for All Stages

Again the simple, economical, easy way proves best in radio. For an amplification unit that will be a real sweet singer without shielding, jockeying or fuss, Coto Specials in all stages is your sure and money saving bet. Great for reflex circuits too. Low price ($2.50) is their least recommendation. Jobbers are ordering in thousand lots.

The Original Honeycomb Wound Coils

Years of factory experience in quantity production account for combined extra quality and low price.

$1662.00 Earned IN ONE SEASON

A NEW BUSINESS—BIG BUSINESS

A Business to Enthuse Over—
The "Ideal" Lawn Mower Sharpener

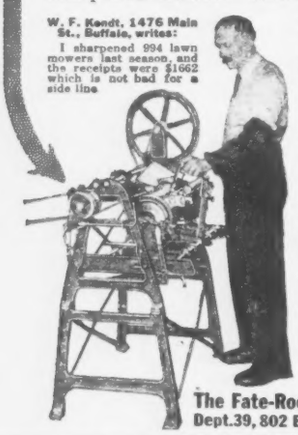
A wonderful invention that sharpens lawn mowers scientifically—quickly—perfectly; does the work as nothing else can.

Fred C. Milkert of Melrose Park, Ill., writes:

"The Ideal Lawnmower Grinder put me in business, starting in the basement of my home and forcing me now for the third time to move into bigger quarters. Today the dream of my life—a shop of my own—is realized. With a machine like yours and a little hustle any man can have a business of his own and be independent."

You Start Now No town is too small. Lawn mowers are dull—owner doesn't know where to get them sharpened. Mowing the lawn dreaded because of dull or improperly sharpened mower. Lawn mowing is healthful, invigorating and pleasant when Mower is "Ideally" sharpened. You do the work scientifically—you are in big demand.

W. F. Kondt, 1476 Main St., Buffalo, writes: I sharpened 994 lawn mowers last season, and the receipts were $1662 which is not bad for a side line



Lawn Mowers Sharpened to Razor Edge—

People glad—owners delight in mowing lawn with mower sharpened on an **"Ideal."** Mower runs light—click-click-click and the grass is cut. Build permanent business for yourself. Start now!

Write Today

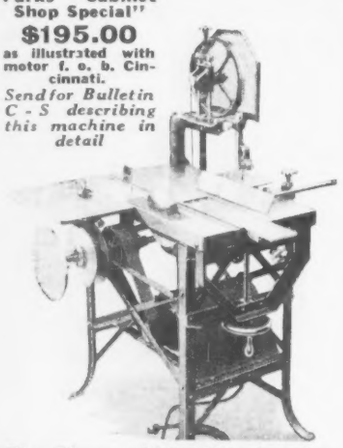
Get our proposition Free We have detailed illustrated book to send you. Write today for our proposition.

USE THIS — MAIL IT TODAY
The Fate-Root-Heath Company
802 Bell St., Dept.39, Plymouth, O.
Please mail at once details of your complete proposition.

Name .....
Address .....
.....

The Fate-Root-Heath Company
Dept.39, 802 Bell St., Plymouth, O.

Parks "Cabinet Shop Special"
$195.00
as illustrated with motor f. o. b. Cincinnati.
Send for Bulletin C-S describing this machine in detail



The Biggest Little Woodworker Ever Built!

You'll want this sensational Parks combination woodworker right away for your shop—includes 8-inch rip and cross-cut saw, 4-inch jointer, band-saw, borer, shaper, sander, and universal motor. Only $195 complete! Lathe attachment only $15 extra. First-class Parks angle-steel construction, all joints electric-welded. Steel table-top. The newest thing in small shop equipment. Guaranteed 10 years.

The Parks Ball Bearing Machine Company
1547 Knowlton St., Cincinnati, O.
Canadian Factory: 200 Notre Dame East, Montreal, Can.

PARKS
WOODWORKING MACHINES

MAN IS ON THE BRINK OF A MIGHTY DISCOVERY

Sir Oliver Lodge says he hopes this discovery will not become generally known until mankind has sufficient wisdom to handle the power that it will loosen. But scientists have already tapped this source of power! Not yet harnessed perhaps but yet plain enough that ANY AVERAGE PERSON can to a large extent demonstrate it in daily life.

With the use of this ENERGY you can accomplish anything humanly possible. This FACT has been proven by the actual experience of thousands of people during the last twelve months in whose hands we freely placed this amazing discovery. You not only "get the idea" but it applies itself to your affairs within a few days.

Nothing Impossible

Literally thousands of people changed their lives almost overnight by this revelation.
With this secret Col. Adams of Salt Lake City made over $4,000 in a few days.

Unless this power will immediately and practically WORK for you, unless you can demonstrate it as clearly as a child demonstrates electricity by turning on the electric light, IT IS WORTH NOTHING TO YOU. For all men are not equal. Doubt, fear, suspicion, distrust, irresolution are chains that make slaves of many.

Five Days' Free Trial

Simply send your name, postcard will do, we will mail you postpaid, CLEAR, POSITIVE, SIMPLE instructions that you can begin applying IN A VERY FEW HOURS. You have five days to study and examine it without cost. If it proves valuable in obtaining concrete results we leave it to you to pay us within 5 days what in your judgment it is actually worth to you or what you honestly can afford to pay. If you think it is worth nothing, pay nothing, simply return it. This plan seems strange and unusual. But the power and secret are ALSO strange and unusual. You WRONG only yourself if you delay.

The CARNAGEY INSTITUTE
H. C. CARNAGEY, President
504 Hayes Bldg. Dept. 605 Kansas City, Mo.

Home Workshop Chemistry

(Continued from page 126)

months. A mold was shaped in it by scratching it gently with a knife. Metal cast in this way is much easier to handle than if it is in lumps or flat pieces.

The same low melting alloy can be used to solder the connections of a radio coil, the heat being applied by a match or a small alcohol lamp or blowpipe. The solder will melt quickly and run freely under the heat of a match.

Soft pewter and other low melting metals are easily soldered with a soft solder consisting of 5 parts (by weight) of bismuth, 3 of tin, and 2 of lead. It melts at approximately 212° F. Care must be taken in soldering easily fusible metals together to be sure that the solder melts at a lower temperature than the metals to be united.

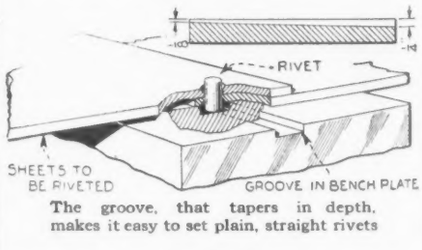
Fluxes are used with most solders in order to absorb oxygen and prevent the metals from forming oxids. Calcined borax, which is a neutral salt, has the property of dissolving the oxids formed while soldering. Another neutral soldering flux often employed with success is powdered rosin or tallow, although beeswax is better than the last-mentioned substance. If none of these substances or no commercial flux is at hand, a wax candle will often serve with fair success.

Aluminum is most difficult to solder. It takes up oxygen too readily when heated, and also gives up its heat too quickly. The presence of phosphorus in a solder prevents oxygen absorption. An aluminum solder can, therefore, be made of 2 parts of silver, 9 parts of aluminum phosphide, 39 parts of tin, and 50 parts of zinc. This solder requires no flux.

IN CONNECTION with this article on solders and fluxes, read Mr. Laraby's "Hints on Soldering," on page 134.

Groove in Bench Plate Aids in Setting Rivets Neatly

TO RIVET two plates or sheets together, when using plain rivets made for the occasion out of straight round steel, is often a troublesome job. One side will have a full head, while the other side is apt to be skimpy. A bench plate with a groove planed across its rough side will solve this difficulty. The groove



The groove, that tapers in depth, makes it easy to set plain, straight rivets

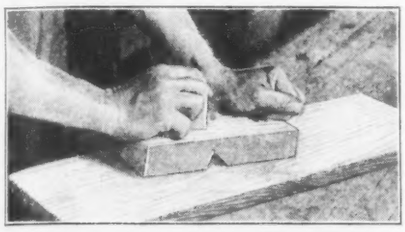
should be planed with a taper, as shown, ⅛ in. deep at the shallow end and ¼ in. at the deep end.

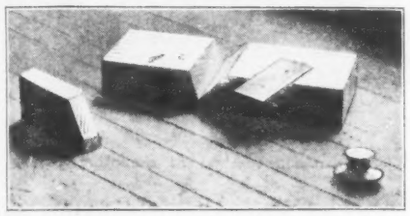
When using the grooved plate, slide the sheets with the inserted rivet back and forth until the proper projection on both sides has been obtained and then rivet the upper side. Next, turn the joint over and the other end of the rivet will be projecting sufficiently to head up well.

Making a Wooden Holder for a Small Cabinet Scraper

FOR the finishing of small hardwood pieces, this plane-like scraper is easier to use than the ordinary flat steel cabinet scraper. It is easy to make, too. As the necessary steel, wood, and screws were found in the shop, the total cost for the one illustrated was five cents, spent for the knob at a five-and-ten-cent store.

Cut off a 10-in. length of 2 by 4 in. wood, and, 5½ in. from one end, make a notch very slightly more than halfway through the block. The sides of this notch should form an angle of about 90 degrees. This angle is not important, but





The scraper in use and the few parts that are necessary for making the tool

the angle that the back surface makes with the block, is; it should be within a degree or two of 10 degrees from the perpendicular.

If an old hand scraper is available, the blade can be cut from it, 4 in. long and as wide as the rear surface of the notch, plus ⅛ in. Two elongated holes are made in the steel by drilling two pairs of holes ¼ in. apart and cutting out the intermediate pieces with a chisel. The blade then can be set after the cutting edge has been worn down by sharpening. Round-head screws hold it in place.

Should this type of steel not be at hand, excellent material is obtained from an old kitchen knife blade of sufficient size or even the bit of a small plane.

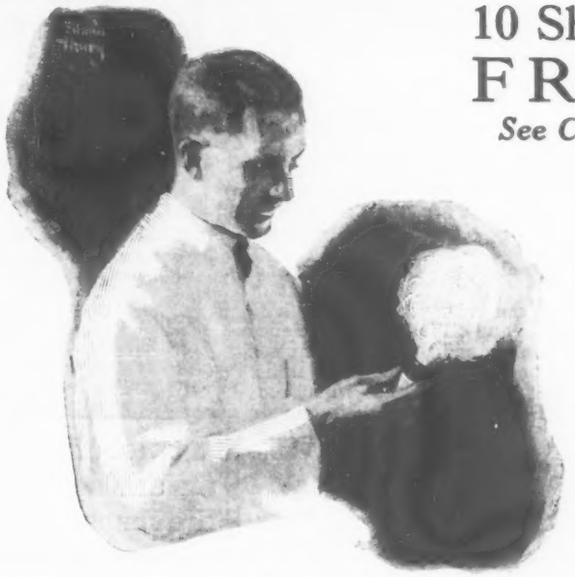
The front hand grip is a wooden knob attached by a long wood screw, and the rear grip is shaped from a block of white pine 1 in. thick. It is held by long screws through the top.—DALE R. VAN HORN.

Fixed Radio Condensers

EFFICIENT transmitting and receiving condensers for radio work can be made from old photographic plates.

The emulsion is first washed from the plates with hot water and the surfaces are then rubbed down with carborundum cloth, which takes off the gloss and leaves something akin to a frosted surface. The same result can be accomplished by exposing the plates to the fumes of hydrofluoric acid.

The glass is coated with ordinary aluminum paint and connections are made with small tinfoil strips sandwiched between the plates.—CARTER FISKE.



10 Shaves
FREE
See Coupon

My Life Work

The finest Shaving Cream you will ever know

By V. K. Cassady, Chief Chemist

GENTLEMEN:

I have devoted my life to soap chemistry. We have here developed some of the greatest soaps created. One of them—Palmolive—is the leading toilet soap of the world.

Our greatest ambition for years has been to perfect the supreme Shaving Cream. And we have done that, beyond question. Millions of men now concede it.

1,000 men consulted

Our first step was to ask 1,000 men what they most desired in a Shaving Cream. All of them agreed on four things.

But one requirement, and the greatest of all, is something no man mentioned. They were not scientists. They did not know the prime requirement in a shaving soap. That is, strong bubbles which support the hairs for cutting.

We made 130 tests

We made up 130 formulas which we discarded. Each was better than the one before. But none, in our opinion, reached the utmost in a Shaving Cream.

Then we attained, by many times over, the best Shaving Cream in existence. Someone may make a better one, but not much better. Today Palmolive Shaving Cream is monarch in its field. It is winning men by the millions, as they try it.

* * *

Don't change from the cream you like now until you see what Palmolive Shaving Cream does. But make this test. You owe it to yourself and to us. Try ten shaves, and let the results show if we have excelled the rest.

Excels in 5 ways

It multiplies itself in lather 250 times, so one-half gram suffices for a shave.

It softens the beard in one minute. No hot towels, no finger rubbing.

It maintains its creamy fullness for ten minutes on the face.

Super-strong bubbles support the hairs for cutting.

The palm and olive oil blend acts as a lotion, leaving fine after-effects.

2304

PALMOLIVE
SHAVING CREAM

© P. Co. 1924

Follow with Palmolive After Shaving Talc—
An invisible way to that well-groomed look

10 SHAVES FREE
Simply insert your name and address and mail to
THE PALMOLIVE COMPANY
Dept. B-623, 360 N. Michigan Ave., Chicago, Ill.

.....

.....

Science Says Use Nu-Gas To Cook and Heat

Up-to-date homes being built without coal bins because there's a better, cleaner, easier way to cook, bake and heat, by burning free air.

A twist of the wrist on arising. Intense fire almost instantly

"Don't buy coal at present price," says a Domestic Science Expert. Don't buy it at *any* price. You can get far better results by burning free air and oil in the way science has recently discovered. The government does it; the big ships do it; factories do it; and new homes are being built without coal bins or wood-sheds because their owners have adopted the new, clean, dustless, dirtless, laborless device which fits in any stove.

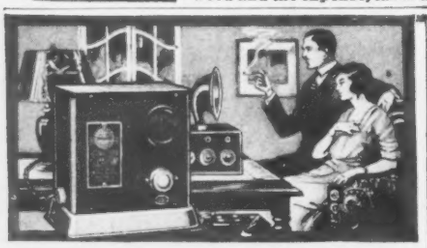
Oil and Free Air Make Wonder Heat

Science has shown that one part of coal oil (kerosene) the cheapest of fuels, can be mixed with twenty parts of air (by a remarkable burner) and the result is a wonderful heating and cooking gas. Cheaper than city gas. No fires to build. Heats at twist of the wrist. Heats largest rooms in a few moments on coldest morning. Heats oven evenly for baking. No dirt, smell or soot. Saves work, saves furniture, saves health. And a new way has been found to cut useless parts, so that, of all burners, the NU-HEAT (the latest one) is the best and lower in price. Installed in a jiffy in your present range, heater, furnace—then you are no longer a slave to coal and wood and the expense, labor and dirt they bring. Absolutely safe. Sent on 30 days free trial. Amazing ironclad guarantee.

AGENTS Make $50 to $200 a week. Full or spare time. Personal co-operation. Write quick for exclusive territory and free sample case offer.

Free Book About Remarkable Way to Burn Air Learn how to cut housework in half. Learn to save by having all the heat you want but only when you need it. Learn cheap way to have the warmest, cleanest, cosiest home in town. Just say "send Nu-Heat information Free." Mention if you have heater, range or furnace. No obligation to you whatever.

Wade Hill Manufacturing Co.
Dept. C-41, St. Louis, Mo.



Charge Your Radio or Auto Battery at Home Overnight for a Nickel

with the

GOLD SEAL HOMCHARGER

—the world's best as well as its most popular rectifier. Simple, dependable, practically silent and absolutely safe. Beautifully finished in mahogany and gold—an ornament for the finest living room.

WHY PAY MORE—OR GET LESS?

Why buy a 2 or 3-ampere rectifier without ammeter requiring from 40 to 50 hours to charge your battery and costing twice as much to operate when, for the same price, you can secure the genuine 5-ampere GOLD SEAL HOMCHARGER which does a better job in one-third the time and at half the cost? Fitted with high grade ammeter (eliminating guesswork) charging cable and battery clips—no extras to buy. For sale by all good dealers, $18.50. ($25.00 in Canada.)

INSIST ON THE GOLD SEAL

It's your guarantee against substitution and appears on name-plate and package. No other charger is just as good.

GENUINE GOLD SEAL HOMCHARGER UNQUALIFIEDLY GUARANTEED

RADIO FANS, ATTENTION!

FREE Ask your dealer or send direct for free HOMCHARGER list of broadcasting stations and GOLD SEAL bulletin.

The Automatic Electrical Devices Company
131 West Third St. Cincinnati, Ohio
Largest Manufacturers of Vibrating Rectifiers in the World

I PAY MEN $75.00 a Week and up

I pay men $75.00 a week and up by my plan which I want to send you at once. Be your own boss, work where and when you like. You can do fine even without previous experience. Biggest values—positively sell on sight.

Profits in Advance

My plan pays biggest profits and commissions in this line, all paid in advance, we attend to delivering orders and collections.

Sell *fine* Tailoring

Astonishing values get orders easy when you show samples of our tailored to order, all wool, suits and o'coats—one price $31.50. Our advertising helps you take orders quick.

FREE

This big, fine sample outfit furnished free, contains 100 all wool big samples, all one price $31.50, fine colored fashions, stationery, supplies, tape, etc. All in classy, fine carrying case. Also complete sales manual, we place you in Big Money Class.

$31.50 ONE PRICE W. Z. Gibson

W. Z. GIBSON, Inc., Chicago Ill.
161 West Harrison St., Dept. C-25

Please send me your plan for $75 a week and up, also FREE outfit and sales manual.

Name _____

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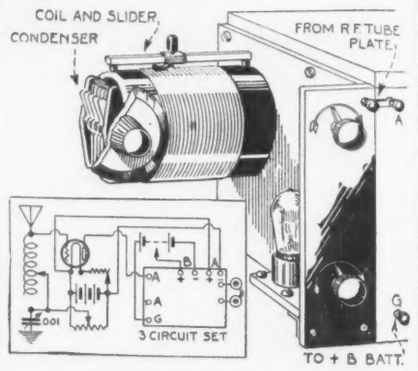
City _____ State _____

Adding Tuned Radio-Frequency to a Triple-Circuit Receiver

TO ADD a stage of radio-frequency to an ordinary three-circuit receiver is a simple matter if the method illustrated is followed. The unit is fastened directly to the end of the cabinet without marring it or necessitating any change in the wiring of the radio set.

Even in midsummer, when reception generally was poor, I was able to hear Omaha, Neb., Davenport, Ia., Detroit, Mich., and Dallas, Tex., on my set in Baltimore, Md. These stations came in clearly on my homemade loudspeaker,



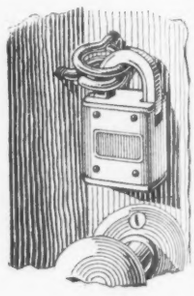
Circuit of one-tube radio-frequency amplifier and method of mounting parts

four tubes being used. Without the radio-frequency amplification the best I could do was Atlanta, Ga.

Either make a tuning unit with 60 turns of No. 22 enamel-covered wire on a tube 3½ in. in diameter and 4 in. long, as shown, or obtain an old-fashioned single-circuit tuner. Fasten a 43-plate variable condenser at one end of the tube and then follow the illustration and wiring diagram in completing the unit.

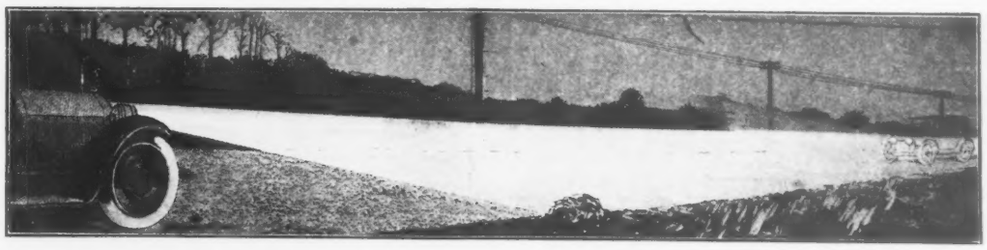
The potentiometer is 300 or 400 ohms and the rheostat should suit the type of tube used. For local reception and whenever you do not wish to use the radio-frequency unit, only the aerial and ground connections need be changed and the plus B battery line disconnected from the radio frequency tube. The unit is not adapted to a receiving set of the single-circuit type.—JOHN A. MAHON.

Two Screweyes Serve in Place of a Hasp and Staple



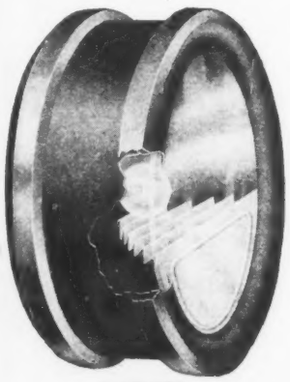
IN ORDER to padlock a door that opens away from the side on which the padlock is to be used, it is often a problem to arrange the hasp and staple so that they cannot be removed too easily. A good method is to place two ½-in. screweyes, as shown, one in the door and the other in the door casing. When the lock is in place, it is practically impossible to remove it without the key, or by cutting off one of the staples with a hacksaw.—H. L. WHEELER.

A Perfect Glareless Headlight At Last



Distributors—Agents and Dealers—Can Make $3,000 to $15,000 or More a Year

The Detroit Safety Headlight Devices absoiutely solve the greatest menace to automobiling—the headlight glare. This is a new, simple device and fits any model of any car. Installed easily and quickly by anyone. Used with low priced plain glass lens. It adds style and dignity to any car. It absolutely concentrates the light down on the road, not up in others' eyes. Drive with all the courtesy of the road with bright lights on. The glare is positively eliminated. Will last a lifetime. Will not rust, corrode or deteriorate. Meets every legal requirement. They are the best headlight devices made and stand any test.



PATENTED

Detroit Safety Headlight Devices Sell On Sight

They sell on sight—a demonstration sells anyone. Easily demonstrated in store, home or on car. Sold on 30 day trial—never taken out. Appeals to fairness—no one wants to drive others to death in ditch. Owners urge others to buy. See illustrations as to installation and effect.

Exclusive Territory—Newspaper Advertising—Installed Free

Exclusive territory granted to right men—we run newspaper advertising and arrange for **Free** installation by competent garages. Printed matter and cards also furnished. We want men in every county who can handle men and sales and make from $3,000 to $15.000 or more according to territory.

FREE—One Set. Free Introductory Advertising Offer

One set of Detroit Safety Headlight Devices in a neighborhood makes everyone want them. It's the best kind of advertising for our representatives. Therefore, for a short time we will sell two sets for the price of one ($2.00) or one set at wholesale price of $1.00, postage paid. Buy two sets, sell one easily at $2.00—yours will be free. This offer is open to everyone to advertise the devices. When territory Representatives are appointed offer ceases—so act now. Easily installed by anyone. Get literature—clip FREE coupon, fill in, pin $1 or $2 bills to coupon—act quickly NOW.

Motor City Syndicate

Offices: 1217 Book Bldg., Dept. 43

Detroit, Mich., U. S. A.

FREE—One Set Free Coupon

Motor City Syndicate
Offices: 1217 Book Bldg., Dept. 43
Detroit, Mich.

Gentlemen: Without obligations, please send literature of Detroit Safety Headlight Devices. Send such offer as I have marked below.

Do you want to sell?.....

What territory?.....

Make of your car.....Model.....Year....

Make of other car.....Model.....Year....
Fill in both for $2.00 offer.

Just use Dollar Bills if sending money.
Enclosed $..... for offer as marked above. These to be mailed postage paid.

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Address.....

City..... State.....

Every Lincoln Record is a masterpiece. The very acme of perfection. The tone is wonderful in softness, in richness, character and quality. The finest Dance, Vocal and Instrumental music produced by

ARTISTS OF HIGHEST SKILL

The Lincoln selling plan is amazing. It cuts out retail profit and every unnecessary expense between the factory and you and gives you a product of enormous production direct at an introductory advertising price so low that you cannot afford to turn it down. We expect

A MILLION USERS IN SIXTY DAYS

This is your opportunity to get the newest hits or any records you like for $1.98 and a few cents extra for postage. You get 5 double faced 10-in. genuine Lincoln Records. 10 Selections.

SEND NO MONEY

Pay the postman when the records arrive. Clip this advertisement and mail it today, check the records you want, we have them. If there are records you want, not listed give name of selection, but allow us to substitute. Thousands of our customers find our selecting Dept. very satisfactory. Lincoln Needles, 400 for 25c medium or loud. Order at once as many sets as you wish in lots of 5.

Check the Records You Want

	Vocal	Somewhere A Voice Is Calling At Dawning (I Love You)	Fox Trots	Midnight Rose My Cherry Blossoms
		My Wild Irish Rose I Hear You Calling Me		Somebody's Wrong Where Rainbows End
		Dear Old Girl—Tenor Solo Silver Threads Among The Gold		Last Night On The Back Porch St. Louis Gal
	Instrumental	National Emblem March "El Capitan"—March		Covered Wagon Days I Love You
		Narcissus—Concert On The Beautiful Blue Danube		Hi Lee Hi Lo Salt Your Sugar
	Vocal	Indiana Moon—Tenor Solo I Want A Big Red Apple on a Stick		Cut Yourself A Piece of Cake Passionetta
		I've Got A Song For Sale Dixie Stars Playing Peek-A-Boo		No, No, Nora (With Vocal Chorus) Look For The Happy Ending
		Swingin' Down the Lane That Old Gang of Mine		Oh! Min (With Vocal Chorus) Those Beautiful Eyes
		Yes! We Have No Bananas My Sweetie Went Away		Not Here—Not There Land Of Cotton Blues
	Hawaiian	Three O'Clock In the Morning Kilima Waltz—Hawaiian Duet		Pretty Peggy "Vanities of 1927" My Carolene Girl
		Ua Like no a Like One-Two-Three-Four	Waltz	Roses of Picardy Roll Along Missouri
	Laughing Records	Laugh and The World Laughs Country Days Surely Were It		Just A Girl That Men Forget Nijigo Nengo (Fox Trot)
	Fox Trots	Stealing to Virginia An Orange Grove in California		Indiana Moon Band Plays "Home Sweet Home"
		The House of David Blues Tell All The Folks in Kentucky		Dreamy Melody Rose Dear

Don't forget to order needles

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226 WEST LARNED DETROIT, MICHIGAN

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☐ Traffic Management—Foreign and Domestic
☐ Railway Station Management
☐ Law, Degree of LL. B.
☐ Commercial Law
☐ Industrial Management Efficiency
☐ Banking and Finance
☐ Modern Business Correspondence and Practice
☐ Modern Foremanship and Production Methods
☐ Personnel and Employment Management
☐ Expert Bookkeeping
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☐ Commercial Spanish
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Without one penny of advance payment let us place in your hands to see, to examine, to inspect, to admire, to approve, a real masterpiece in watch creation. A watch **guaranteed to last a lifetime,** which passes the most rigid inspection and measures up to the exacting requirements of the Great Santa Fe Railway System, and other great American trunk lines.

Page 12 of our Watch Book is of Special Interest to You

Ask for our Watch Book free—then select the Watch you would like to see, either the famous Santa Fe Special or the 6 position Bunn Special, and let us explain our easy payment plan and send the watch express prepaid for you to examine. No Money Down. Remember—No money down—easy payments buys a master timepiece—a 21 Jewel guaranteed for a lifetime at about half the price you pay for a similar watch of other makes. No money down—a wonderful offer.

SANTA FE WATCH COMPANY
380 Thomas Bldg. Topeka, Kansas
(Home of the Great Santa Fe Railway

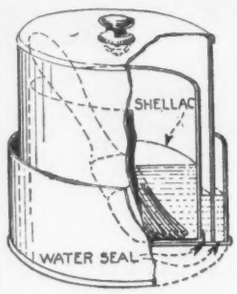
Santa Fe Watch Co.,
380 Thomas Bldg., Topeka, Kan.

Please send prepaid and without obligation your Watch Book free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name.....
Address.....

Three Tins Form Container that Is Evaporation-Proof

IN THE home workshop as well as in garages and shops where shellac, gasoline, thinned paints, or similar liquids are used, this evaporation-proof container is well worth making. Ordinary tin cans such as are used for paints or food products are the only material needed.

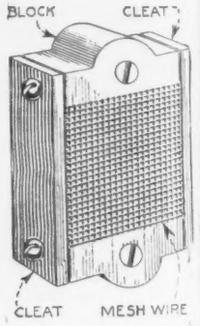


The lid rests in a liquid seal

The bottoms of the inside and outside cans are soft soldered or sweated together. The inner chamber is used for the liquid to be protected from evaporation, while the outer is used for the oil or water used as a seal. The cover is another tin with a knob affixed to it. When it is in position, the evaporation of the shellac or other material is effectively checked.—H. S.

Indestructible Match-Scratcher

THE surface of a common sandpaper match-scratcher quickly becomes worn and smooth and useless. A match-scratcher that will last a lifetime may be made quite as easily and cheaply from a block of wood covered with wire screening of 15 mesh or finer. The screening provides a durable and rough surface.



Scratcher made with wire screening

The block may be cut in a variety of pleasing designs and the screening fastened on its surface by two thin cleats screwed on the sides. These scratchers are readily made in quantity for clubs, poolrooms and smoking-rooms.

Soap Models for Castings

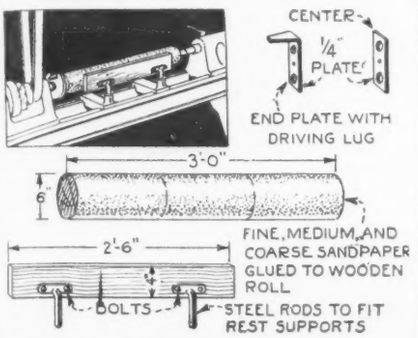
SMALL soft metal or Babbitt-metal castings for models can be made without an original to cast from by using soap to form the pattern.

The materials required are Babbitt metal, plaster of Paris, and a bar or two of white soap of good quality. Using a compass, ruler, and triangle, mark on the soap the desired shape of the part to be cast and cut it out with a narrow-bladed knife. If any holes are to be left in the casting, punch them in the soap first.

Begin the mold by filling any holes full of plaster of Paris mixed with water. Then surround all the model except one side with plaster. After it is thoroughly hard, dig out the soap, using bent and hooked pieces of wire for reaching into difficult recesses. Bake the mold in a hot oven for at least half an hour to remove all moisture, and pour in the molten metal.—ALDEN JOHNSON, N. Y.

Sanding Roll Is Useful Addition to Wood-Turning Lathe

THIS sanding roll has been used for a considerable time on a 6-ft. lathe for finishing woodwork, including moldings and house trim. The body of the roll, which is made of white pine or other wood, has two plates, one with a plain center and the other with a driving lug. To



A wooden roll covered with sandpaper is placed in the lathe for finishing work rapidly

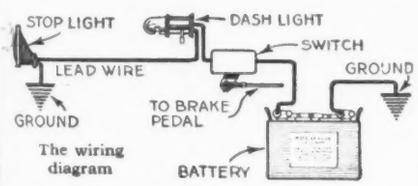
insure a true surface, the drum is turned after the plates are affixed. On the drum are glued three grades of sandpaper—coarse, medium, and fine.

In connection with the sanding roll, a long double steady rest is used. This is made by mounting a piece of oak edgewise on two steady rest supports, as shown. The only need is the occasional renewal of the sandpaper.

Using Dash Light as Telltale for Auto Stop Signal

WHEN the stop light on an auto fails to operate, there is generally no way hat the driver can tell. If, however, this lamp and the dash light are wired in series, neither will operate if one is out of order.

An advantage of this plan is that when touring in the country, where the stop



The wiring diagram

signal is not used often, the connection can be broken by merely turning off the dash light switch. This saves the battery appreciably. The bulbs in both dash and signal lights should be the same candle-power. Since they operate in series, two bulbs designed for 3-volt circuits make a satisfactory unit for a 6-volt system.—GLEN F. STILLWELL, Collinsville, Ill.

Aluminum Runningboard Plates Cover Worn Floorboards

MANY used cars show more wear on the front floorboard than anywhere else because of the constant "digging in" of the driver's heels. Two low-priced aluminum runningboard plates will cover these worn spots and make an improvement well worth the small outlay of money and time necessary.—R. C. T.

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From no knowledge of radio—to licensed operator. From operator up the opportunity ladder to the big jobs at the top. And a life of fascinating interest, well paid. That is every man's chance now that the famous course of America's oldest radio school is offered for *home study.*

The Radio Institute of America is conducted under the auspices of the Radio Corporation of America, the greatest radio organization in the world. This insures the most thorough and up to date instruction and therefore means preference for positions when you earn your government license.

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Please send me full information about radio opportunities today, and your
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Keeping the Home Shipshape

How to do the odd jobs that save time, temper, and money

Soldering Hints

IN KEEPING any home shipshape, soldering plays an important part. Countless odd repairs can be made with a soldering copper. Gutters and downspouts can be repaired, pans and kitchenware patched, broken metal parts fastened together, and even jewelry mended. For electrical wiring and radio work, of course, a knowledge of how to solder thoroughly and quickly is very essential.

For my own use I have two coppers, one weighing about ½ lb. for ordinary work, and a heavier one for soldering seams and larger work. Such coppers may be bought at any hardware store, but if one can obtain a piece of copper about 1½ in. in diameter and 3 in. long, it is very easy to make a soldering copper. Simply bore a ⅜-in. hole across the copper, about ¾ in. from the end, and bend a ⅜-in. iron rod, about 14 in. long, through the hole to hold the copper firmly. A wooden handle should then be added and the point of the copper tapered bluntly.

Many repairs in the home can be made with a soldering copper

The copper can be heated in a gas-stove, by means of a blowtorch, or with any convenient source of heat. Let the most intense part of the flame heat the body of the copper, so as to lessen the danger of burning off the tinning on the point. With an electric soldering copper, the heating problem is, of course, taken care of automatically.

If the point has not been previously tinned, the first thing to do is to give it a coating of tin, which really means a coating of solder. This is done by brightening the point with emery paper, applying flux in the form of rosin, acid or soldering paste, and melting solder over the surface. Then rub the copper quickly on a cloth until the point looks like bright tin. If the copper is ever greatly overheated, the tin will be burned off, and it will have to be retinned.

The first essential in soldering anything is to clean the parts. If the metal is thoroughly cleaned with emery cloth, file, and scraper, if the iron is hot, if a good flux is used, and if the parts are held so that they cannot move in relation to each other while the solder is being applied, there is no difficulty in making any ordinary soldered joint.

In soldering leaking pots and pans apply the solder on the inside. If the hole is too large to fill with solder alone either plug it with a tiny wad of steel wool or apply a tin patch.

A step in advance of plain soldering is known as "sweating." To make a sweated joint, clean the parts, warm them a little and apply solder and flux till the surface of each is covered with a coating of clean solder. While the solder is still molten, wipe off as much as possible with a rag. This leaves the surfaces covered with a very thin plating of solder. Then bring the joint together and clamp firmly, apply the soldering copper to the joint and hold it until the solder seeps through the other side. Let the parts cool naturally. This makes the

(*Continued on page 135*)

There Is Still Time to Enter Prize Contest for Best Shipshape Home Ideas

AS THIS issue of POPULAR SCIENCE MONTHLY goes to its regular subscribers and is placed on the newsstands about February 10, there is still time for a good many readers to enter the Shipshape Home Prize Contest announced last month. Letters must be in the office by February 20.

The subject of the contest is: "How I Keep My Home Shipshape." For the best letters containing practical, novel, and ingenious ideas on this subject, POPULAR SCIENCE MONTHLY will give a first prize of $25, a second prize of $15, and a third prize of $10, and will purchase at space rates as many other contributions as are available.

Don't simply catalog a number of odd jobs; pick out one or two of your own ideas that have been particularly successful in reducing the upkeep cost of your home.

Keep your letter short—not more than 400 words. Inclose photographs or sketches, if possible, to illustrate ideas.

The winning letters will appear in the June issue. The contest will be judged by the Board of Editors and their decision will be final. Unavailable letters will be returned if accompanied by stamped and self-addressed envelope.

Address Shipshape Home Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

The Shipshape Home

(*Continued from page 134*)

strongest possible kind of soldered joint.

For hardware use hard solder, but for use in connection with jewelry and soft metals, have on hand a piece of soft solder. Soft solder melts at a lower temperature than hard solder. In every case it is necessary to use a solder that melts at a lower temperature than the metal to be soldered. It is not advisable to use acid when soldering tin; use a paste or rosin. Always wash the article thoroughly after soldering so that the soldering won't deteriorate or, as we say in the shop, "rot."

I have often seen amateurs use a soldering copper with a long-drawn-out point, evidently with the idea that it would do neater work. This is a mistake, in my estimation, as such a point will not hold the heat, and unless the work is of such a nature that a blunt point cannot be used, the blunter it is, the better.

Solder will not flow into a joint unless the metal is as hot as the melted solder. It can be heated by passing the copper over the surfaces a number of times after the solder has been applied to the joint opening.

When soldered joints are made outdoors, such as in connection with a radio aerial, it is advisable to paint the soldered parts, in order to check the crystallization of the solder. Thick asphaltum paint is easily obtainable and excellent for this purpose.—HENRY S. LARABY.

Stopping Small Leaks

HOT-WATER boilers used in connection with furnaces or gas heaters, sometimes leak at the riveted seam. Calking or patching with the usual repair plugs does not repair these leaks very successfully because of the uneven surface.

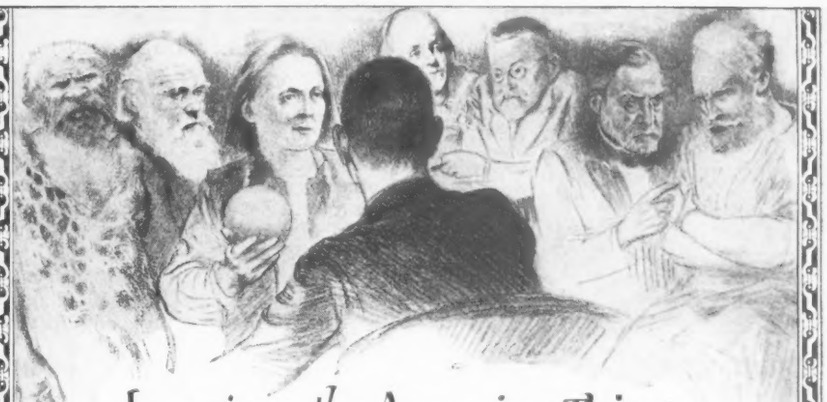
An easy method of repairing this type of leak is to place a large handful of bran, such as is used for horse feed, into either the top of the hot-water tank or the expansion tank of the hot-water radiator heating system. The bran is so glutinous that it lodges in any small openings in the system and seals them, provided they are not too wide. Such repairs are often as enduring as the remainder of the plumbing work.

After placing the bran in the hot-water tank, it is advisable not to draw any water overnight, to give an opportunity for the leaks to close.—G. A. L.

Laying Linoleum

THE edges of inlaid linoleum, especially when new, sometimes curl up where two pieces are butted together. To prevent this and the resultant cracking of the edges, obtain waste curtain cloth, the left overs from window shades, or old discolored shades, and tear in strips about 5 in. wide. Beginning at one end of the seam, place the curtain fabric flat on the floor, with the crack between the two pieces of linoleum in the center, and spread a portion of glue along the top of the curtain strip and on the under side of the linoleum near the edge. After the

(*Continued on page 136*)



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The Shipshape Home

(*Continued from page 135*)

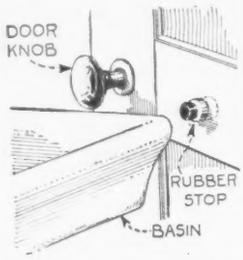
glue has dried a little, press the linoleum firmly down on the strip, first one side and then the other. Use flatirons or any other weights as the work progresses and be careful not to crack the linoleum. If possible, have the room thoroughly warm.

After the glue has dried hard, a good application of floor wax will fill up the crack and prevent dust and dirt from gathering in it.

This method was used in the writer's kitchen over two years ago, and the floor covering is perfectly flat. Irregular cracks can be treated in the same way, providing the carpet can be raised, and this sometimes will save a floor covering that seems about gone.—R. C. T.

Neat Door Stop

THE bathroom door in our home swung back against the lavatory in such a way that both door and basin would quickly be damaged. An ordinary doorstop could not be attached to the basin, and yet if it were placed on the door it would make a dangerous projection at a height to catch one's clothing or perhaps strike and injure some one.

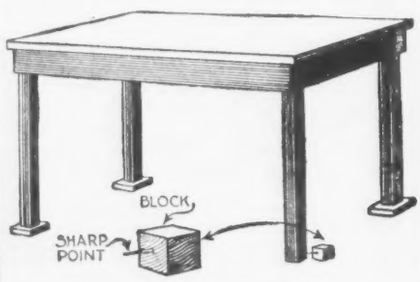


The difficulty was solved by purchasing a rubber tip such as is used in a round metal socket on the foot of a crutch. A hole was bored in the door at the point where it struck against the basin and the rubber was glued in it. Now when the door swings back, only the rubber tip strikes the basin.—ED HENRY.

Adjusting Table Legs

TO EVEN up the legs of a table is sometimes not an easy job. Try this plan and you will have no difficulty at all.

First, find a level floor, then place the short legs on three blocks of even height. Get a fourth block and in it drive a needle or other sharp point at the same height as the top of the other blocks, and mark around the long leg.



Either this simple scriber or dividers may be used to mark the long leg

Given three long legs and one short one, place the table firmly and level, then drive your pointer into a block of wood at the base of the short leg and mark the other three with it.—E. A. MCCANN.

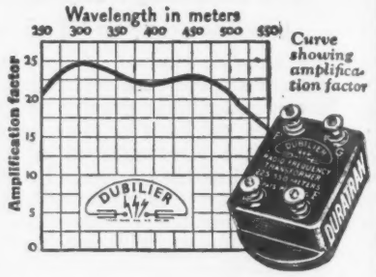


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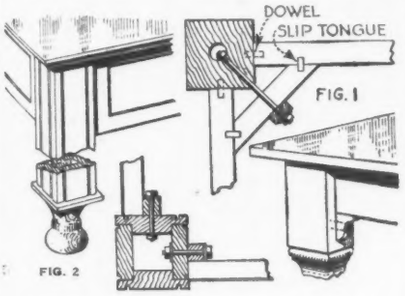
Table Construction Simplified for the Amateur Woodworker

FROM the standpoint of the home worker, the two methods of table construction illustrated have several advantages. Neither requires the usual dowels or tenons, and both allow a table to be taken apart for storage or shipment.

In constructing the table as shown in Fig. 1, a hole should be bored in the top of the legs at the center to a depth equal to half the width of the table rails. This hole should be large enough to receive a bolthead and washer inserted through a slot cut diagonally from the hole to the inside edge.

The corner piece, which is engaged by the bolt, is the same width as the rails and is cut on a miter at the ends. The slip tongues between the corner piece and the rails must be hard wood about ½ in. thick, cut the short way of the grain.



Neither of these tables requires elaborate joinery, as bolts hold the legs and rails

The short dowels are merely to locate the rails and to counteract any tendency they have to slip down; the small brackets serve a similar purpose, and one or the other may be omitted.

The dowels and slip tongues should be glued only at one end so that the table may be taken apart. The top may be fastened to the rails with screws, strips, or iron plates.

The legs of the table shown in Fig. 2 are made hollow. The grooves hide the joints and also conceal the heads of the nails used in fastening the parts together. In finishing, these grooves can be colored in the fashion now so popular.

Hardwood blocks are glued and screwed to the table rails, and either stair-rail or ordinary bolts are used to connect the parts. One bolt through each block at the top is sufficient; a heavy wood screw will serve for the bottom fastening.

With a top about 24 by 40 in. and with one large drawer, this table is suitable for use as a library table. With the drawer omitted and with narrower rails, it makes a neat table for occasional use in odd corners.—A. E. ELLING.

Tightening Auto Spring Clips

BROKEN springs in passenger-cars and trucks are a common occurrence even when precautions to tighten the retaining clips may have been observed. The nuts to the spring clips may be pulled up fairly tight, yet the spring leaves may not be solidly together. The better method of tightening the spring clips is to do this when the car or truck is loaded, as it will be found the clips can be tightened considerably after the load is on the car.

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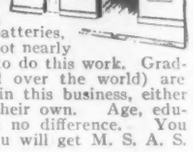

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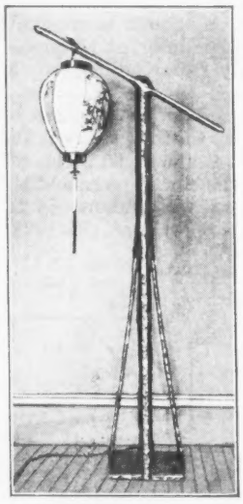
Framework Covered with Putty Forms Unique Floor Lamp

THAT an inexpensive and artistic floor lamp can be made mainly of putty seems absurd, yet the lamp illustrated was built in that way and it has been in use for more than six months. The putty on it is thoroughly dry and as yet it has not cracked nor fallen off.

The materials needed to make such a lamp are 7 pieces of wood, a lamp socket and plug, 10 ft. of lamp cord, a few nails, 25 cents' worth of shellac, 35 lbs. of putty, about 10 cents worth of gilt or paint, and a Chinese lantern.



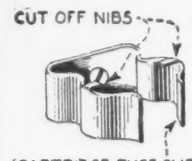
The lampstand is covered with putty

The wood can be rescued from almost any trash heap. It does not matter whether it is surfaced or rough, although putty sticks best on the rough. The shellac makes the putty stick to the wood better. Paint only a small surface at a time and apply the putty before the shellac dries.

If the putty is worked into the wood by hand, the dents left by the fingers give the lamp an odd finish. The putty will not harden for some time, but the lamp may be finished, gilded, painted, or touched up, as the maker sees fit, and used immediately, provided it is not roughly handled.—W. C. HAZEL, Hollywood, Calif.

Tool Racks Made from Old Cartridge Fuse Clips

DISCARDED cartridge fuse clips from old switchboards are to be found in the scrap box of almost every electrical repair shop. These may readily be made into excellent toolholders for the shop or used in the home to hold kitchen utensils.



For holding tools

All that is necessary is to remove the two little nibs or stops that ordinarily retain the end of the fuse in place. This can be done quickly by bending them back and forth with a pair of pliers and then filing off the rough spots where they break. The clips are then fastened to the wall or bench backboard with screws. The sides of each clip may be bent to fit the particular tool it is to hold.

A row of these clips forms a very neat rack for holding sets of bits, chisels, carving tools, and the like. They may be used equally well on the bench backboard or in a tool cabinet.—S. W. B.

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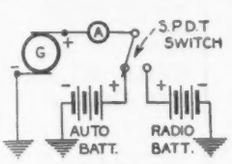

Diagram of battery-charging connections

If the brushes of the generator are set up to charge from 12 to 16 amperes, and if not a great deal of night driving is done, one will find that by this system both batteries will be kept charged and in good shape.

The generator must, of course, be of a 6-volt type, and both batteries of the kind used for autos. A battery made especially for radio work cannot be charged at so high a rate.—DALLAS BOUDEMAN, JR., Kalamazoo, Mich.

Drawing Ink Flows Freely in an Ordinary Fountain Pen

ALTHOUGH it is generally believed that India ink cannot be used in an ordinary fountain pen, I have been lettering and writing with drawing ink from the same fountain pen for more than a year. The secret lies in keeping the ink flowing. When not in use, the pen is placed in a corked test tube containing a little water. Don't change from regular writing fluid to India ink, however, without first giving the pen a thorough washing.—N. G. NEAR.

Walking on Auto Tubes

SHOES and arctics can be kept in repair, sometimes into the third year, by being re-soled with rubber from old auto tubes. It takes only a few minutes to resole a shoe; in fact, three pairs can be repaired in an hour at a cost for materials of only a few cents a pair.

The air-cured cement now sold is such an improvement on the cements of a few years ago that the rubber soles can be made to stick very well. A thin fabric or repair gum for bicycle tire repairing, which has both surfaces prepared to unite with air-cured cement, is used as an interlayer between the old tubing and the soles of the shoes. The other materials necessary are coarse sandpaper to roughen the rubber surface, a small wood rasp to roughen the leather, a pair of shears, a sharp knife, a light hammer, a file, and nippers for cutting nails.—E. A. WADSWORTH, Grand Forks, N. D.

Why Teeth Discolor

Tobacco, food, etc., stain the film

THE clouds on teeth lie in the film-coats. The remedy is to remove the film. Millions now daily combat the film, and the glistening teeth you see everywhere show what it means.

You must fight film

Film is that viscous coat you feel. It clings to teeth, and no ordinary tooth paste can effectively combat it.

Soon it becomes discolored by tobacco or by food, then forms a dingy coat. That is how teeth lose their beauty.

Film also holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay. Germs breed by millions in it. They, with tartar, are the chief cause of pyorrhea.

Under old methods very few escaped these film-caused troubles.

Now dental science has found two ways to fight film. One disintegrates the film, one removes it without harmful scouring.

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That tooth paste has come into world-wide use, largely through dental advice.

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You will be glad to know a method which brings results like these. Cut out coupon now.

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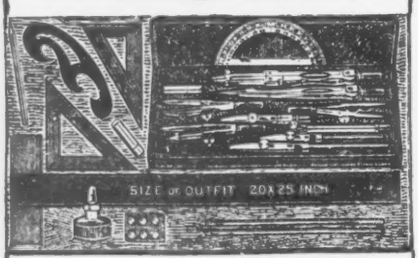

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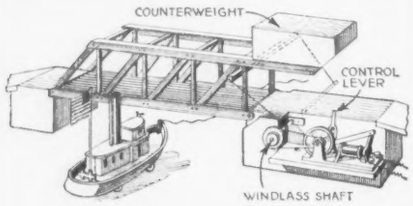
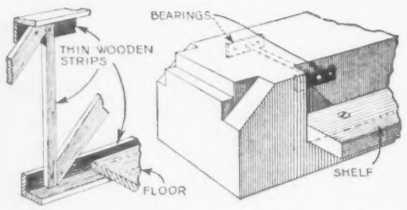
Realistic Toy Lift Bridge Is Operated by Electric Motor

A FEW strips of wood ⅛ in. thick—cigar-box wood will do—several blocks, a thin board or two and a cheap toy motor are the only parts required to build this novel toy electric lift bridge. The span is 14 in. and the width of the roadway or bottom piece is 3¼ in. The cross-section of the bridge is 3½ in. wide and 4¼ in. high over all. The proportions can, however, be altered to suit any miniature railway system.





The complete bridge and details of the main foundation pier and span members

The main foundation pier is cut from a block 3 in. thick, 4¼ in. wide, and 9½ in. long. A hole is drilled through it for the main shaft, which is ⅛ in. in diameter, and small brass bearing blocks are fastened on each side, as shown. A shelf, in this case 2¼ by 7½ in., is fastened to the block to hold the motor.

The other pier is cut from a block 3 by 4 by 3½ in. The main members of the bridge span are strips ⅛ by ⅜ in. fastened with glue and escutcheon pins. The counterweight is a block 3¼ by 4½ by 2 in.—DONALD W. CLARK.

Test Battery Restores Fading Signals of Vacuum Tube Set

HOW many fans remember the old-fashioned buzzer test for crystal sets? Not many perhaps, but I have found a way to test even the bulb set in a similar way.

Take an old and weak (the weaker, the better) dry cell, and connect the negative side of the battery with the ground terminal of the set. Connect the positive side of the battery in series with a push-button and the antenna binding post.

With the set I am using—a straight two-circuit loose-coupler hook-up with ungrounded secondary—this device accomplishes the following: (1) When signals fade, pushing the button brings them up to regular strength. (2) If, when the pushbutton is pressed, no noise is heard in the phones, it either indicates a loose wire or an incorrect connection. (3) Sometimes, when an inductance hum comes in too loud, pressing the button causes the noise to disappear. (4) It tests the condition of the regular batteries by the comparative loudness of the test signals.—WALTER LUHRS, Secaucus, N. J.

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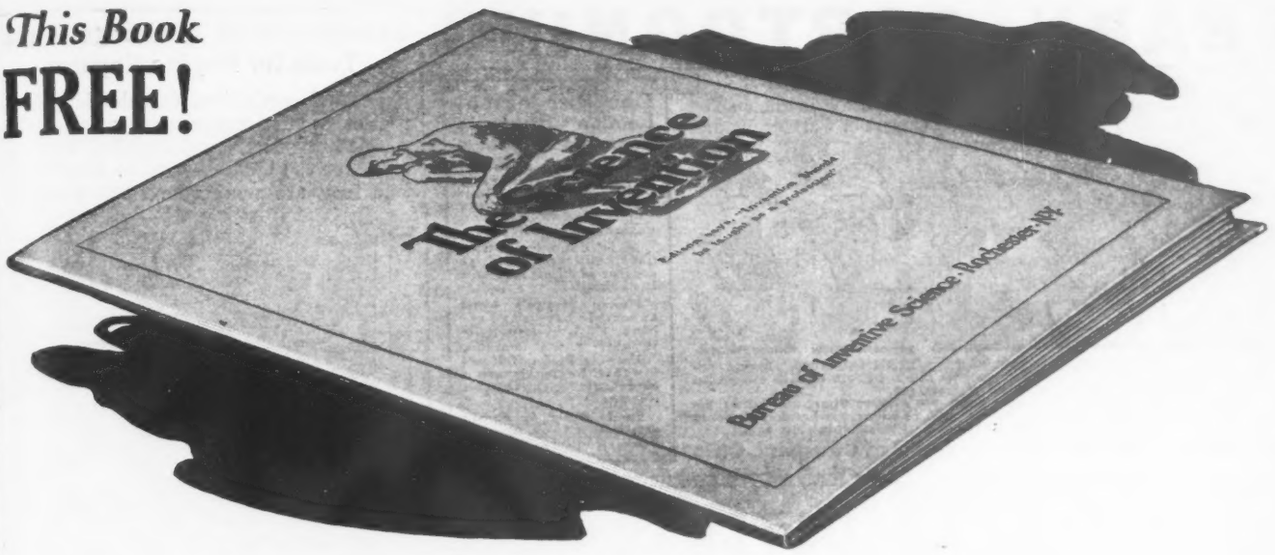

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And how many times a day you "fix things." A leaky faucet, a rattling window, a wabbly table—you fix hundreds of things like these every year. And, though you may never have realized it, every time you "fix things," you use the very definite exact principles which are the basis of Inventive Science!

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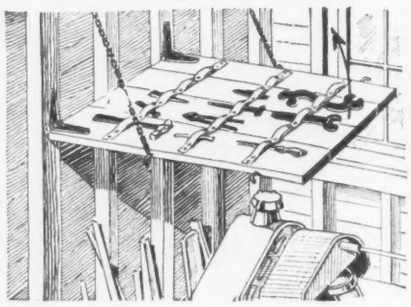
Swinging Shelf in Garage Holds Tools for Engine Repairs

VALVE regrinding, decarbonizing and other auto-engine repair work can be speeded up surprisingly if a shelf bench is made for the home garage, as illustrated. The tools are arranged on this board in



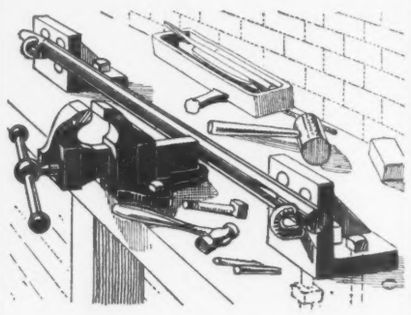
Tools for tuning up the engine are immediately available on this folding shelf

holders or strap pockets so that they are instantly available. The shelf is hung in the forward end of the garage, adjacent to or under a window if possible. The height when lowered is enough only to clear the radiator of the car.—G. L.

Vise Provides Pressure for Simple Bench-Straightening Fixture

IN STRAIGHTENING parts on the bench it is customary to use the vise to grip one end of the part and to pull or press the opposite end with the hands. Several trials are often required to rebend the part to its former straightness. An improvement on this method is the use of the straightening fixture illustrated. This is used mainly in automobile repair work, but it is generally serviceable.

In the rear of the vise are two small angle plates bolted to the bench top. The



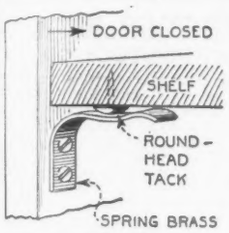
Held against two angle plates, the bent part is straightened by the vise ram

faces of these plates are drilled with holes for hook bolts, which are used to hold against turning the parts to be straightened.

The work is lined up and fastened so that the screw or ram of the vise will bear against the center of the bend. The controlled pressure of the vise screw makes it possible to use a straight edge or other means to test the work. Irregularly shaped parts, such as crankshafts, camshafts, connecting rods, and parts of an auto's steering mechanism, can be straightened advantageously in this way because the bench top provides a clear, flat surface for blocking and testing.

Simple Spring Catch Holds Cupboard Door Shut

CUPBOARD and closet doors frequently cause annoyance by refusing to stay shut unless equipped with a spring catch that is both dependable and strong. Such a catch may be made in a few moments' time out of a small ½-in. wide strip of spring brass and a round-head tack.

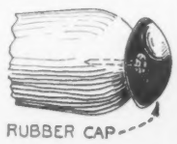


The catch engages a round-head tack

The brass is bent as shown and fastened on the inner side of the door so that the curved end of the spring touches lightly the under side of the middle shelf. The round-head tack is driven into the bottom side of the shelf in such a position that the spring will slide over it and snap into place. This holds the door closed, but still it can be opened readily.—S. W. B.

Rubber Cap for Screwdriver

ON MY hand screwdrivers I use a rubber cap, as shown, to eliminate friction in the palm of the hand. A small hole is drilled in the end of the handle and a rubber-head tack is driven in. Working the tack around a few times will make it turn freely.

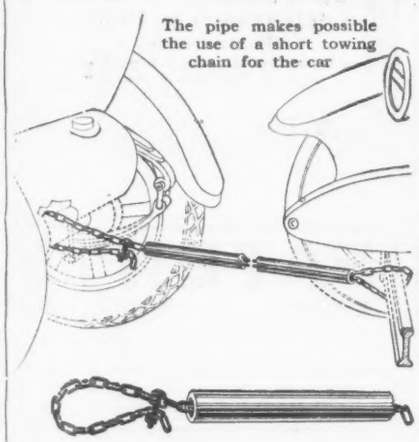


This scheme makes a straight screwdriver work almost as well as a ratchet, besides providing a cushion for the palm of the hand.—W. T. M.

Wrought-Iron Pipe Improves Emergency Towing Chain

WHEN a short chain is being used for towing a disabled car, it is advisable to run the chain through a pipe.

This method was devised for towing a car stranded in the country where the longest chain available was a trace chain. This was so short that the brakes were ineffectual, but by placing a section of wrought iron pipe, about 10 ft. long, over the chain, the tow of more than 20 miles was made without an accident.


The pipe makes possible the use of a short towing chain for the car

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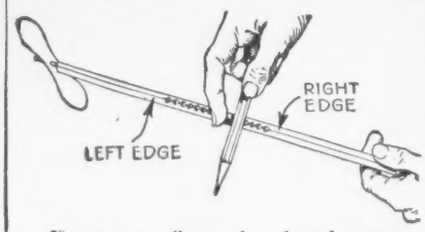
Trick Toy Propeller Mysteriously Reverses Its Revolution

RUB the notched stick of this puzzling little toy and the propeller wheel will spin in one direction. Keep on rubbing and it will suddenly stop and begin to turn the other way—that is, if you know the secret of the toy.

The propeller itself is simply carved from a stick of soft wood three or four in. long. It is mounted by means of a small nail on the end of a thin square stick, preferably hard wood, twelve or



How the propeller revolves depends upon whether the left or right edge is touched

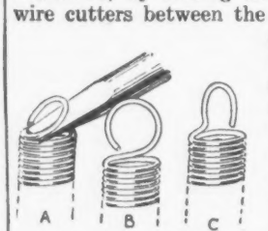
15 in. long. Along one edge of the stick a series of notches are cut, as shown.

To operate, hold the propeller stick horizontally by the extreme end and rub the notches with a pencil or other stick, at the same time pressing lightly with the forefinger against what is marked in the illustration as the left edge. To change the direction of revolution, lift the forefinger away from the left edge and press lightly against the right edge with the thumb. This can be done without noticeably altering the position of the hand or fingers, so that very few observers will see what has caused the propeller to change its direction.—WALTER MARKOWSKI, Camden, N. J.

Shortening a Steel Wire Belt

STEEL wire belts—that is, belts consisting of a long coil of springy steel wire—are so widely used now that it is a good thing to know how to shorten or re-join them.

Cut off the belt, when it is to be shortened, by forcing the blades of the wire cutters between the coils and snipping straight through. Insert s small screwdriver under the first loop (*A*) and pry it up until it can be seized with a small pair of pliers. Bring up the loop with the pliers until it is upright, and then twist it around so that it extends diametrically across the coil (*B*). The loop must be bent up at such a point that the end of the wire will allow the loop on the other end of the helt to hook in, yet make the opening no larger than necessary (*C*).



Steps in forming the connecting loop

Steel wire belts do not work well unless they fit closely in the grooves of their pulleys. Put such a belt on a pulley designed for a round leather belt, and it will slip and be practically useless. In a pulley with sharply pitched flanges, it can wedge itself in firmly.

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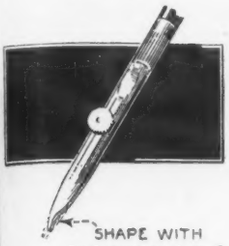
Draftsman's Ruling Pen Ground for Use in Lettering



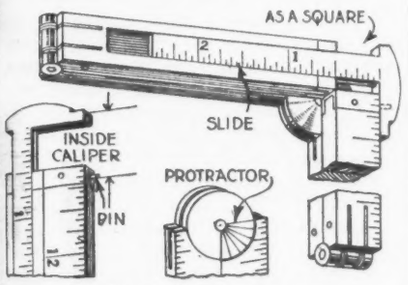
Forms letters of uniform thickness

ALTHOUGH there are many kinds of lettering pens on the market, an exceptionally useful one can be made in a short time from a regular draftsman's ruling pen. The point is altered to the shape shown with a fine file and a good oilstone or carving slip. The pen can still be used for ruling straight lines.

Improving a Pocket Caliper Rule

IN SPITE of the steel rules and combination outfits in my possession, my most useful tool is a small one-foot, fourfold, wooden caliper rule. Together with a steel tape and scriber, it is always with me.

Its range of service has been extended by grinding the nose off to only ⅛ in. in

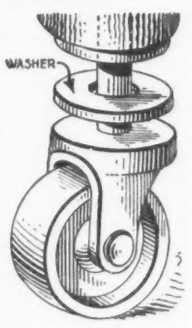


How the rule is used as a square, protractor, and inside caliper

width and inserting a small pin, as shown. This allows the rule to be used as an inside caliper.

In addition, I have marked off the major angles on the principal hinge, and this enables me to measure angles within a fair degree of accuracy. By opening the rule at right angles, the caliper head serves as a guide in making a serviceable square, and the caliper portion can be removed and used when necessary as a depth gage.—E. J. MORRISSEY, West Allis, Wis.

Washers Used to Fix Uneven Legs on Movable Furniture



A PORTABLE workbench we were using about the garage became somewhat wabbly because one of the legs had shrunk until it was shorter than the others. To avoid the work of removing the rollers or casters from the other three legs and sawing them off, we simply placed a washer, as shown, above the roller on the short leg. This is the simplest possible way of making such an adjustment on furniture having casters and saves much trouble.—G. A.

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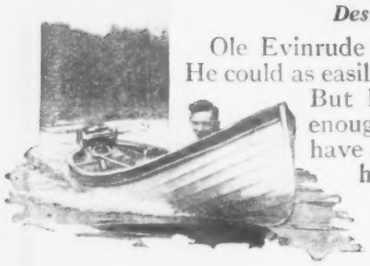

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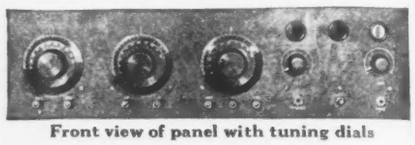
Neutrodyne Set

(*Continued from page 73*)

condensers, the two jacks, and the two rheostats. Then drill holes for the seven binding-posts (if you desire them on the front of panel). Also drill the proper holes for fastening the tube sockets and the rheostats and for fixing the panel to baseboard.

The holes used for fastening the variable condensers are the most important and should be located with the greatest possible accuracy. The purpose of mounting them at the 55-degree angle shown in Fig. 1 is to prevent interaction between the currents in the coils that are attached to the backs of the condensers. Deviation from the true angle by more than a degree

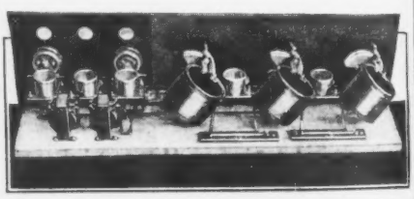


Front view of panel with tuning dials

is likely to result in objectionable oscillation. Fortunately the angle is independent of the distance from center to center of the coils.

Next, cut the sheet copper to size and drill clearance holes as indicated by the dotted lines in Fig. 1. This shield is not absolutely necessary for every receiver, but it always will be an improvement, since it does away with bothersome body-capacity effects. In some receivers that have come to the writer's attention, shielding of some kind was absolutely necessary, for the reason that the neutralizing condensers could not be adjusted to small enough capacity if the shield were absent—*i.e.*, the receiver was over-neutralized, due to inherent capacities between condensers and coils of adjacent stages.

The shield then can be fastened to the panel. The tube sockets *D* and *E* will



Rear view of panel showing three special neutrodyne tuning elements, called "neutroformers"

hold it securely at the bottom and several flat-head machine screws with nuts are sufficient to hold it at the top. Next, mount detector-tube socket *F* and amplifier-tube sockets *G* and *H*. The condensers and coils (neutroformers), *A*, *B*, and *C*, then should be fastened. Examination will show that each transformer has an outer coil about two inches in width and an inner coil about one half inch in width that is placed toward one end concentric with the outer.

The outer coil is provided with a tap about half an inch from the end where the primary or inner coil is placed. The complete units, *A*, *B*, and *C*, should be mounted so that the primary or inner windings are at the upper left (when viewed from front of panel). It is possible to mount the coils so that they all

(*Continued on page 147*)

Neutrodyne Set

(*Continued from page 146*)

slope the other way, but this necessitates longer connections.

After mounting the rheostats, jacks, and binding-posts as indicated in the sketch (*P*, *Q*, *N*, *O*, from 39 to 45 inclusive), the wiring may be commenced. The connections first described are those that carry relatively large radio-frequency currents or are at relatively high radio-frequency potentials. They should be as short as possible and at the same time be kept as far as possible from other wires.

Details of Wiring the Set

Referring to Fig. 1: From antenna binding-post 39 run a lead to point 1, a connection on the inner coil of unit *A*. From 2 run a lead to ground post 40. Then run leads from 3 to $\times FD$ (negative filament of tube *D*), and from 4 to *GD*. Connect shield at 38 with ground post 40. From *PD* proceed to 5; from 7 to $-FE$; from 8 to *GE*; from *PE* to 10; from 12 to $+FF$; from 13 to 19; from 20 to *GF*; from *PF* to 46; and from 46 to 27. (Note that condenser *T* may be placed to better advantage to the right of and under tube *F*.) With the exception of the leads to the neutralizing condensers *J* and *K*, this completes the first group of connections.

The second group includes the low-potential connections, that is, those at low radio-frequency potential. They include the connections that supply the tubes with the direct current and the connections of the audio-frequency stages. In this group the battery connections should be bunched and well insulated to prevent short circuits, while the audio-frequency transformer connections should be short and isolated as much as possible.

The negative filament bus wire begins at the ground connection 2-40 and connects successively $-FD$, $-FE$, $-FG$, $-FH$, and finally the 6-ohm rheostat *Q* at point 23. It should be noted that this wire does not connect with $-FF$ on the detector tube.

The positive filament bus starts at $+FD$, is joined to plus A battery, post 41, and then continues to $+FE$, $+FG$, and $+FH$ in order. A connection also is made to the detector-tube rheostat at 21. Connect also from negative A battery post 42 to $-FF$, to 44 (negative B battery post), to 47 and to rheostat at 24. This connection is termed the "negative battery lead."

How to Mount the Transformer

The positive B battery lead starts at 6, is connected with by-pass condenser *R* at 48, proceeds to point 11 on unit *C* and ends on jack *O*, point 28. A connection is made also from this bus with the proper post at 45. Connect 49 with negative battery lead. The positive detector B battery lead starts at 43 and proceeds to 25.

The next step is to mount the audio-frequency transformers in their proper relative positions on the baseboard. The connection 34 to positive B battery lead should be soldered first at the lead, with the end 34 free. This applies to connections 25 to 30, 26 to 31, 33 to negative battery lead, and 37 to 24, Points 25, 26,

(*Continued on page 148*)

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Neutrodyne Set

(*Continued from page 147*)

33, and 37 should be soldered after the panel is fixed to the baseboard.

There remain only the connections *PG* to 35, *PH* to 29, 36 to *GH*, 32 to *GG* and the connections with the neutralizing condensers, or "neutrodons." These condensers should be mounted as shown, making the connections 15 to *GD*, 16 to 9, 17 to *GE*, and 18 to 14. The condensers consist of two wires, one about one inch and the other about three inches long, which are inserted in the opposite ends of a glass or other insulating tube. The ends of the wires within this tube are separated by about half an inch.

Adjusting Capacity Values

A metal tube about three inches long is arranged to slide over the outside of the insulating tube. Moving this tube so that it covers the gap and finally a portion of both wires increases the capacity, while sliding it away from the gap decreases the capacity. If it is impossible to obtain sufficient capacity by using the two wires as terminals, greater values may be obtained by making connections between the tube and the short wire, or, finally, between the tube and the long wire.

The receiver now is ready to adjust. Connect the antenna with 39 (a fairly large aerial is best for adjusting purposes), the ground with 40, the plus A battery terminal with 41, the minus A battery with 42, the plus 22-volt terminal of the B battery with 43, the minus B battery terminal with 44, and the plus 90-volt terminal with 45. It is well to connect the A battery first and insert the tubes before connecting the B battery. If the tubes light, one can be reasonably sure that no error has been made that will result in burning out the filaments.

With regard to the tubes, UV-201-A or C-301-A should be used in all five sockets. A soft detector tube, such as the UV-200, may be used at *F* if desired; but if this is done, it will be better to substitute a six-ohm rheostat for the 30-ohm specified at *P*.

Tuning in the First Signals

To continue, set rheostats at the "off" position and insert the tubes. Bring the filaments up to normal brilliancy with the two rheostats and insert the telephone plug in detector jack *P*. A strong local station that operates on a low wave (from 300 to 360 meters) is preferred as one on which to make adjustments. Any strong signal will do, however. Station KDKA in Pittsburgh, for example, has sufficient signal strength in New York City.

Suppose you are in New York, and have selected KDKA as the station. Set dials *B* and *C* on 20 divisions and move antenna dial *A* back and forth from 0 divisions to 20. Probably the receiver will be in a very critical and unsatisfactory condition, but with a little care the desired station may be tuned in by adjusting all three dials, although it may be accompanied by all kinds of squeals and beat notes.

Then proceed as follows:

(*Continued on page 149*)

Neutrodyne Set

(*Continued from page 148*)

1. Remove tube *D* from its socket and place a piece of paper over one of the filament prongs (see Fig. 3). A good way to do this is to make a small hole in a piece of paper, put the prong through it, and double the paper back over the bottom. This holds the paper on when removing the tube.

2. Replace the tube, which now does not light up, and retune the dials if necessary. The signal now will be much weaker and the telephone plug should be shifted to the amplifier jack.

3. Adjust the neutralizing condenser *J* by sliding the metal tube until no signal, or at least the weakest possible signal, is obtained. This adjustment is very important and the experimenter should be sure that he actually has obtained a balance. One check is to see whether, when the tube is removed entirely and dial *A* is retuned, the signal again becomes loud, as it should. Also it should be possible when adjusting *J* to actually pass through the minimum and bring the signal up to moderate intensity by continuing the motion of the sliding tube. If this is done, the tube should be returned to the position of minimum signal before continuing.

4. Remove paper from prong of tube *D* and replace that tube.

5. Remove tube *E*, place paper on one of its filament prongs, and replace the tube in the socket. Again retune for maximum signal.

6. Repeat operations 3 and 4 with respect to condenser *K*, dial *B*, and tube *E*.

Receiver Should not Oscillate

The receiver now is completely adjusted and ready for use. It should not oscillate and should produce no beat notes or whistles with incoming signals. To receive other stations the best procedure is to move both dials *A*, *B*, and *C* a few divisions in the same direction. When all three circuits are in tune, a rushing sound will be heard. This noise is called "background," is unavoidable, and is noticeable only in very powerful amplifiers. It is due to atmospheric disturbances such as spark stations.

Continue to move all three dials, *B* and *C* first, then *A*, until the desired station is picked up. Once having heard a given transmitter, the dial settings may be recorded for future reference. Since the settings of dials *A* and *B* and *C* are independent, there will be only one combination of the three dial settings that is correct for any particular wave length.

On local stations the relatively strong signals may be amplified to such an extent as to overload the detector and amplifier tubes. This causes distortion. A remedy is to use a smaller antenna or, if this is not convenient, to detune one of the dials, preferably *A*, until a good quality tone is obtained.

In this article nothing has been said about the theory underlying the operation and adjustment of the neutrodyne receiver. If the reader is interested, he may refer to Proceedings of the Radio Club of America for March, 1923, also published in "Q S T" for April, 1923.

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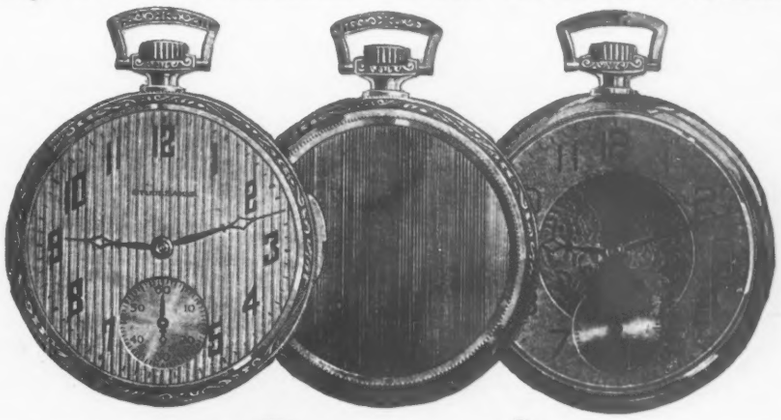

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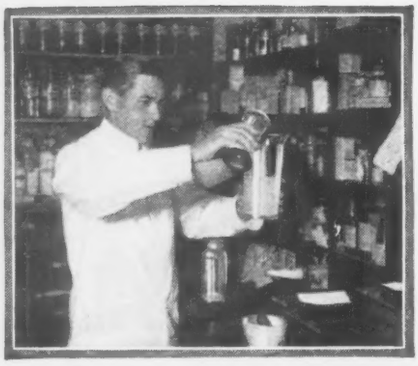

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Perils of Polar Flight

(Continued from page 33)

landing requires either a shed or a mooring-mast, or what is called a "three-point mooring." The latter means simply using several hundred men to pull the big ship down out of the sky. Thus, landing by dirigible would be out of the question if a new continent were discovered in the Polar Sea.

This brings us to the most important problem of all—that of rescue in case of disaster. No battle is properly planned that does not leave open a line of retreat. No arctic expedition is sanely prepared that does not provide a means of escape for its members who may get adrift.

A generation ago the United States Government sent out the Greely expedition to North Greenland and across to Ellesmere Land. It was the best-equipped arctic party that ever had been fitted out. Yet it ended in a tragedy that shocked the country.

The reason for that disaster lay in the fact that lines of retreat were not arranged for in proper detail. There was lack of information about arctic travel; confusion of instructions; misunderstanding of agreements. At Cape Sabine men died by starvation with plenty of food at hand. They didn't know how to get it. Thirty years later at the same Camp of Death, the writer and four Eskimos killed and cached two tons of walrus at the very same time of the year that the last three deaths in Greely's party occurred.

The Difficulties of Rescue

This is not criticism of that unfortunate expedition. The tragic facts are recalled simply to emphasize the almost insurmountable difficulties of this phase of arctic exploration.

Suppose, for example, that the three planes with which the explorer Amundsen is planning to make a polar flight, enter fog just past the Pole. With a poorly directed compass one pilot shifts to the right of his course. His radiator develops a leak, and he is forced down. On landing, he smashes his plane in rough ice. He has food for a month and clothing.

What plans could have been made to find and rescue him?

Briefly, it would take 20 of our best planes working for nearly a month from Point Barrow over 1000-mile lanes to cover properly all the area in which the unhappy man might be stranded. If he should have barely passed the Pole, we should have no plane that could be counted on to rescue him. He could not possibly make land with what equipment he might carry in his plane. Also, during the search, other aviators might get themselves in just such a jam as he would be in.

A dirigible might make a better search. But even a dirigible working from Point Barrow would have to have a mooring mast there. She would be held up by storms. Sleet might drive through her thin envelope and tear one or more of her balloonettes from which would escape the precious helium.

And don't forget that Point Barrow, the supposed base for such rescue work, cannot even be reached by ship to estab-

(Continued on page 151)

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Perils of Polar Flight

(*Continued from page 150*)

lish the base until early August! A fortnight or so later all chance of retreat by sea is closed.

Looks bad for any unlucky flier who crashes ón the polar pack, doesn't it?

Assume that the lost man has with him material from which he can improvise a fairly good radio outfit. Is he safe? Not if we are to consider the troubles that the MacMillan party in Greenland have had with radio communication this winter.

Radio amateurs of the world have been asked by the American Radio Relay League to aid in tests and experiments to find an explanation for the mysterious invisible barriers that for months have screened from Alaska, the United States, and Canadian radio stations the signals sent out from the icebound ships of Amundsen and MacMillan.

We are not crying "Wolf" when we list these few of the problems of a polar flight. But it is a military maxim not to underestimate one's enemy.

There will be no such thing as the widely published "Dash for the Pole by Air." There would be no justification for such a stunt. Peary's work is indisputable. Amundsen's proposed flight from Spitzbergen to Alaska is part of a broad scheme of exploration of which we were informed long ago.

What we are chiefly after in the Polar Air Expedition is to clear the mystery of that great geographical vacuum north of Alaska. In it may be a tremendous body of land with untold riches of natural resources. Only recently five miles of platinum ore were found in the Ural Mountains that run to the Arctic Circle, and 32,000,000 tons of coal in Saskatchewan.

The hazards will be great and the obstacles many. But most of them we can anticipate. So with effective preparation and formidable attack against the icy northern barriers, the results, both scientific and commercial, are bound to justify the effort.

Recent Publications

A résumé of new books on science and invention

The Vault of Heaven, by Sir Richard Gregory, F.R.A.S., emeritus professor of astronomy, Queens College, London. A fascinating introduction to modern astronomy, presented in non-technical language. Illustrated. E. P. Dutton & Co.

Dwellers of the Sea and Shore, by William Crowder. An interesting addition to the Young People's Shelf of Science, edited by Dr. Edwin E. Slosson. Illustrated. The MacMillan Company.

The Complete Campsite Guide and Latest Highway Map of the United States, prepared by the United States Touring Information Bureau, Inc., with the cooperation of the Airway Section of the United States Army Air Service. A handbook of information for the motor tourist, including also an official directory of the airplane landing fields of the country.

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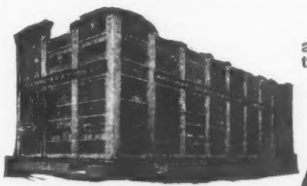

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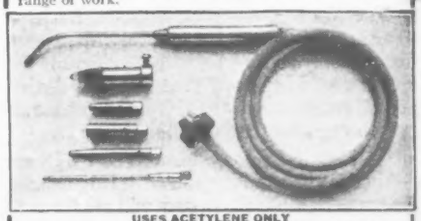

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Seventeen years ago my father saw a friend filling his pipe from a tin of Edgeworth Slice and asked for several slices to bring home to me. It is worthy of note that the package was attractive enough in itself to excite my father's interest in the first place; but when I add that, so far as I am aware, he never used tobacco in any form during his entire life, it is still more remarkable.

Up to that time I was a member of the "Tried 'em All Club." Can I put any more steam behind this testimonial than to say that for seventeen years I haven't spent a dollar for any pipe tobacco other than Edgeworth. The Ready-Rubbed school of smokers enjoys my respect, but for me—give me Edgeworth Slice. Brother, it's a *man's* smoke and it *stays with you!*

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To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Habits Make or Break Us

(*Continued from page 39*)

pulses flow more and more easily as time goes on. This process is true of good habits and bad habits alike. It requires some persistence to form a habit, but once the habit has been formed, it cuts so deep a groove that breaking it is something that only persons of exceptional will power succeed in doing. And a good habit is as difficult to break as a bad one.

Only a few weeks ago I astonished a New York business man by opposing his desire to bring about the retirement from business of his father, who is more than 80 years old. For 65 years this old gentleman has been rising at six in the morning, hurrying to his office, and working through the whole day as hard as his most ambitious young employee. Undoubtedly he has earned his retirement, but, as I told his son, to begin it probably would be fatal. The habits of a lifetime are not to be thrown aside so lightly.

There is nothing heroic about this old gentleman's devotion to business. He is in the grip of a habit as necessary to his well-being as food and sleep. Rest for him, as for others who are addicted to the praiseworthy habit of hard work, would be a dangerous experiment.

Life means activity, and when we cease to be active, the life force runs down in us. Few people ever have died of overwork, but the victims of inactivity are countless.

How to Direct Habits

It has been well said that if we acquire a sheaf of good habits, there will be little time or energy left in our lives for bad habits. And the acquiring of good habits is a matter merely of conscious direction of our mental grooves through our wills. In a previous article I described how the mind will not work except in response to a stimulus from without. No stimulus can be more potent than a conscious effort to direct our habits, a process that psychology has reduced to rule. The following maxims cover the ground thoroughly, and may be applied either in the formation of new habits or in breaking habits already formed:

Begin the task of acquiring or breaking a habit with all the strength and determination you possess.

Never relapse into your old habits, even when you are certain that the new habits are ingrained in you—have become second nature.

Respond instantly to every inward prompting toward actions that tend to aid the formation of the habits you seek to acquire.

Stimulate your habit of effort by performing every day at least one difficult task not connected with the habits you are forming.

As a single, all-embracing principle in the formation of habits, an eminent psychologist lays down this rule:

"Make automatic and habitual, as early as possible, as many useful actions as you can."

In "The Story of the Mind" next month, Doctor Walsh will explain the science of our emotions—what they are and how to use them for profit.

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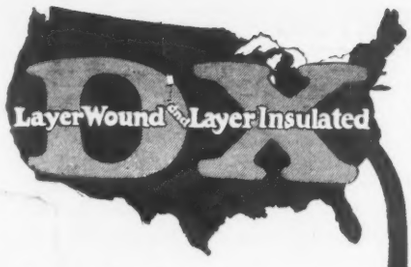

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Easy to Take Orders

No collecting. Pay you every day. Get started at once. Territory given. Write for terms.

PERRY-LUDLOW CO., S-647, DAYTON, O.

Mechanics in the Wilds

(*Continued from page 41*)

doubtful junctions, heated in a primitive forge excavated from a dome-shaped white anthill and hammered on a tree-stump anvil.

After this adventure I joined the forces led by Sir Ernest Shackleton, and for the third time turned south.

I will venture to say that no expedition ever experienced and survived such privations of fantastic perils as beset us during the ensuing two years. For six weeks we forced a passage through ice-armored seas, eventually reaching latitude 77 south. At this point a terrific blizzard from the north compacted the icefloes around us. The open sea now was 1000 miles away and our little ship became gripped in a frigid embrace from which she never escaped.

For ten long, weary months we were mere human flotsam, insignificant and impotent against the overwhelming forces of nature. Our little vessel was fatally crushed and sank when 350 miles from the nearest land—a desolate rock off the antarctic coast. We resigned ourselves to floating on an ice-raft, hoping that some day we might be carried by the drift to the free rolling seas and then in our three small boats reach somewhere!

Where Mechanical Skill Counted

Never before did my fundamental mechanical training assert itself to such advantage. From metal scraps and odds and ends, I constructed our "blubber" stove and cooking utensils. I literally manufactured objects from needles to anchors with four tools—a file, chisel, hammer, and patience.

To conserve our slender supply of matches I made tiny seal-oil lamps from food tins, with wick floats that kept them alight at all times. Thus we always had sufficient fire to start our blubber stove, fashioned from a discarded ash bucket.

For days we drifted, dogged by starvation and aching cold. Then we reached the margin of the pack ice, where we launched three small boats, and headed for Elephant Island, 200 miles to the northward. Through heaving seas of scattered ice the small boats labored, until we safely reached our destination.

On a small, desolate rock ledge, at the foot of the unscalable cliffs of Elephant Island, we passed five months of castaway life before relief came. We turned two boats upside down, heaped snow around them and with odds and ends of material fashioned a home. Here again my mechanical training proved invaluable.

During two years of exile in the antarctic, the great war had been raging. On returning to civilization I was offered the post of official war photographer to the entire Australian Commonwealth military forces.

Collectively, all these various experiences gave me a comprehensive insight into the leadership and meticulous details of expeditions. About three years ago I considered the time propitious to embark upon my own initiatives. The island of

(*Continued on page 154*)

EARLE E. LIEDERMAN
as he is today

If a Jelly Fish Could Slap a Rat in the Face

he would do it. But he can't. He has no arms. Neither does he have a backbone. How much worse off is a man who was given a good backbone and a pair of arms—and won't use them.

NO EXCUSE

We excuse the jelly fish. He never had anything to work on. But there is no excuse for a flabby, round shouldered and flat chested specimen of a man. You were given a perfect framework for a body. You were meant to rule the world, but there is hardly an animal alive which does not show better sense than you do.

CUT IT OUT FELLOWS

Brace up and be the man you were meant to be. Don't try to imitate a jelly fish. Get some pep into you and make a real *He* man out of yourself. Come on and let me help you. I'll shoot a thrill into you that will make your old spine quiver with excitement. I'll build up that chest, broaden those shoulders and give you the huge, muscular arms of an athlete. And that's not all. Your lungs will start pumping real oxygen into your blood, purifying your entire system. Those old cobwebs in your brain will disappear. Your eyes will radiate the life within you. You will have a spring to your step, and every move you make will show new life and energy.

IT'S NOT TOO LATE

I don't care what your present condition is. The weaker you are, the more noticeable the results. All you need is a framework and enough ambition left to say "I'm ready. Let's go!" I'm going to put one full inch on your arms in just 30 days. Yes, and two inches on your chest. But that's only a starter. Then watch 'em grow. I'll put pep into your old backbone and build up every muscle on your body so that your own friends won't know you. This is no idle talk, fellows. I don't promise these things—I guarantee them. Come on then and make me prove it. That's what I like.

Send for My New 64-Page Book "MUSCULAR DEVELOPMENT" It Is Free

It contains forty-three full page photographs of myself and some of the many prize-winning pupils I have trained. Many of these are leaders in their business professions today. I have not only given them a body to be proud of, but made them better doctors, lawyers, merchants, etc. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques.

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What I Learned About Old Age

By Byram C. Kelley, A.M., LL.D.

CERTAIN new facts about old age, recently disclosed to me, constitute the most startling information I have ever received. I am 40 years old myself. I had begun to wonder if I would soon begin to "break" —to lose my old-time pep and aggressiveness, my stamina and resistance to disease. I wondered if I would soon be subject to the class of ailments which seems so prevalent among men past 40. Then through a mutual friend, I made the acquaintance of a member of the American Association for the Advancement of Science, who has recently brought to light most interesting facts about the peculiar conditions common to men past middle age.

Why Many Men Are Old at 40

I had often wondered why so many men begin to lose their vigor and alertness when they are scarcely out of their 30's—yet others, at 60 and 70, seem to be in the prime of life. There must be some reason for this difference. And I found out exactly what this reason is.

65% Have Gland Trouble

I have learned that 65% of all men past a certain middle age have a disorder of a little gland, called the prostate. And prostate disorder is not only the direct cause of much distress, often necessitating operation, but it displays itself in many parts of the body, mental as well as physical.

Common Middle Age Ailments

Here is an important cause for many ailments which heretofore have been simply taken for granted as "old age" symptoms—sciatica, aches in back, legs and feet, frequent nightly risings, nervousness and irritability and frequent dizzy spells indicating high blood pressure; and I learned how, by an astonishingly simple new method, that these disorders would be eliminated in many instances in a short time, without drugs or operation—a treatment that reaches this gland directly—yet is so convenient that any one can apply it in their own home.

10,000 Men Find Relief

73 Years Young

But most surprising of all, I find that 10,000 men have already found relief. Statesmen, bankers, lawyers, doctors, in every section of the country are using and endorsing the method. I read many letters. One was from a man in Colorado. "73 years young is my age," he wrote, "yet for years I suffered with prostate trouble. Used medicine to no avail—had about given up hope when a doctor recommended your treatment." Just think of a man 73 years old being restored to the health and buoyancy of youth! And it is within the reach of every one. There are no drugs, no books, no electric rays.

All Explained in FREE Book

If you are troubled with any of the disorders mentioned, if you have chronic constipation or prostate trouble, you should send for a vitally interesting free book, written by this scientist, called "Why Many Men Are Old at 40." It describes this splendid treatment and shows how you may regain much of your youthful vigor and be free from certain disorders. No obligation. But write at once—the edition is limited. Simply mail request to **The Electro Thermal Company, 4031 Main St., Steubenville, Ohio,** the concern that is distributing these books for the author.

Mechanics in the Wilds

(*Continued from page 153*)

New Guinea became the goal of my ambitions. It was one of the few remaining territories where vast areas remained unexplored.

Experience inclined me to concentrate the efforts of the main expedition to Western Papua, a region where the inhabitants still exist in all their lawless, primitive barbarity. I set out for this expedition equipped for every contingency. Two seaplanes and a large light draft vessel, which would serve as a tender, were my units of transport. The personnel comprised six specialists in various branches of science and a large assortment of trustworthy natives. The vessel was fitted with a powerful wireless installation, and the seaplanes with transmitting sets. Our departure base was Port Moresby, Papua.

The tender was given two days' lead in order to reach a predetermined destination in the heart of the swamps 300 miles to the northwest. Upon receiving a wireless that the vessel had reached the objective, the seaplanes set off to effect a junction. No machine had ever flown through these skies before and the effect produced on the native mind was to elevate us to the realms of the supernatural. It was a great moment when we located our vessel through a smoke screen signal and landed beside her in the heart of cannibal territory.

Pigs Sacrificed to "Flying Demons"

The natives deserted the village for a week, until, actuated by curiosity and the sight of abundant presents, they gradually overcame their fears and friendly relations were established. Regarded as gods by these primitive people, we were held in highest reverence, while the machines were regarded with superstitious awe. In order to propitiate our "flying demons," pigs were sacrificed each evening, and amid much ceremony were placed on the cockpits of the machines.

Owing to the extremely turbulent conditions of the upper atmosphere, flying above these swamp regions was fraught with great hazard. The wireless was of incalculable value, and made possible the speedy location of the machine in case of a forced landing. Keeping this highly essential radio equipment in repair gave me frequent opportunities to exercise my ingenuity and mechanical skill, for radio parts are not readily replaced in the jungle.

The engine of our boat also evidenced a striking aptitude for burning out valves. I replaced these as necessity arose with valves I filed by hand from scrap iron, for I had no lathe on which to turn them. Like other light draft vessels, the boat sometimes failed to pump water for its engine, due to the formation of air pockets below it as it rolled. I remedied this difficulty by placing in the water system a sealed drum connected with the pump and the sea and with a pipe extending from the top to above the deck. Atmospheric pressure tended to keep the water level in this drum at the same level as the

(*Continued on page 155*)

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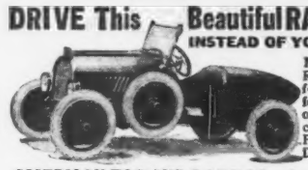

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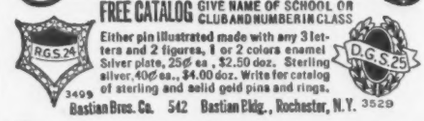

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(Continued on page 154)

(Please write or print plainly)

Morrison

Loud Speaker

Use Your Phonograph for Radio

To really enjoy radio you require a loud speaker that reproduces all broadcasting in full volume with rattle, vibration and distortion eliminated. Your phonograph has a sound-box that cannot be excelled. So attach a Morrison Loud Speaker to the tone-arm of your phonograph and you have a perfect combination—a scientifically developed loud speaking unit reproducing Radio's wonderful concerts through your phonograph's incomparable sound-box. It is the refinement of radio enjoyment.

A little dial on the Morrison enables you to adjust the tone, soft or loud, to suit your taste. Further than that, Morrison is fool proof—requires no technical skill nor constant adjustment to operate.

This remarkable loud speaker complete with a 5 foot cord costs only

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Every Morrison Loud Speaker is sold on a satisfaction or money-back guarantee. Our 2-color catalogue describes Morrison fully—we would like to send you one free.

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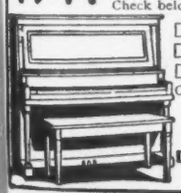

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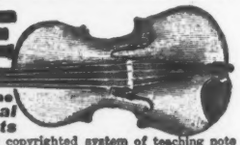

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Siegerland School of Music, 1815 Orchard St., Chicago, Ill.

Mechanics in the Wilds

(Continued from page 154)

sea, so that there was always a water supply for the pump.

We encountered adventures almost innumerable in the wilds of New Guinea. On one occasion, a party of us, visiting an interior village supposedly friendly, was ambushed by bowmen. The chief of the village attempted by ruses to lead us to the place where his bowmen waited. There the savages had stuck poisoned arrows obliquely into the ground, so that if we fled, we would run against them. Becoming suspicious of the wily chief, we retired at last, avoiding the arrow traps and covering the bowmen with our rifles.

The arrows of the natives dropped behind us as we paddled to our boat and sped down the river.

Owing to our constant change of location, it was impossible to house our airplanes and protect them from the weather. After three months' exposure to the rigors of the tropical climate the fabric became so rotten as to make the machines unairworthy. Accordingly, they were flown back to Australia, while the scientific party proceeded up the Fly River into the unexplored heart of the country.

Here a new tribe was discovered dwelling amid the remote reaches of an inland lake, comprehensive scientific work was carried out, ethnological collections secured, and an extensive aerial survey made. The entire scientific records are now in the Australian Museum at Sydney.

In my own career I have found tools so useful that I have reached the conclusion that manual training is an essential course in the curriculum of every primary and secondary school. Schoolmasters are too likely to overlook the fact that nature has endowed the human organism with hands as well as a head.

An early training in practical mechanics is likely to develop individualism and solidity of nature. Whether, in after years, the boy becomes a banker, a lawyer, or just the indispensable clerk, he will find that an early mechanical training has been the least of the many mental encumbrances forced upon him in the days of schoolhood. Anything can be accomplished if you devote yourself to it mechanically and theoretically. The job is done if you always will bear in mind these six words:

Find a way or make one!

Physical Spendthrifts

(Continued from page 44)

amount of muscular work done by a student. The work consists of raising an eight-pound weight attached to one finger. The apparatus, which we call the "ergograph," has one serious defect: It does not really show when a man is tired, for when he is exhausted for eight pounds he can still lift seven pounds and may continue to do so for some time.

The usual procedure is to have several men in turn exhaust themselves for eight pounds, then remove a pound to find that they can lift seven pounds without any serious effort. When they are exhausted for seven pounds they are asked to rest

(Continued on page 156)

The Opinion of 1,000 Others

To find out what influences ambitious men and women to enroll with the American School, an advertising agency sent out a questionnaire to one thousand names, taken at random from our student rolls. The answers to three of these questions show very clearly how our School is regarded by our students, both before and after enrolling.

Why Students Inquired About Our Courses

31.5% wrote only to the American School, because our advertisements impressed them more favorably than the advertisements of other home study schools.
27.0% had heard of the American School before.
23.7% answered several home study school advertisements, so they could select the best.
15.1% were recommended to our school by a friend or acquaintance who had taken one of our courses.
2.7% inquired for various other reasons.

Why Students Considered Taking a Course With Us

37.4% wanted to qualify for better positions.
22.5% wanted assistance in their present work.
20.7% wanted more information on the subject for which they enrolled.
11.2% wanted to prepare for college entrance examinations.
7.4% wanted to "brush up" on subjects previously studied.
.8% enrolled for various other purposes.

What Students Really Think About Our Courses

97.2% say our courses are "Good."
1.4% say our courses are only "Fair."
1.4% say our courses are "Not what they expected."

When you take the average opinion of 1,000 people, selected at random, about some one thing, you will get a definite idea as to the worth of the thing. The average opinion of these 1,000 people is that our courses are O. K. Do you need further proof? If you want to get ahead and are considering a course of practical training, you will find that the American School is the best place to get that training. From us you will get the best grade of training at the lowest cost. And further—

Our Money-Back Guarantee Protects You

You cannot lose when you enroll with us. If after you have finished your course you are not absolutely satisfied, if you do not believe that the training we gave you will help you to get ahead, just write us and we will refund to you every cent you paid us. Mark the coupon. Your request for information puts you under no obligation and no AGENTS WILL BOTHER YOU.

American School
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American School

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For over a quarter of a century, Big Engineers, Educators and Business Men have recommended the American School. They know that our long experience as an educational institution guarantees better training at less cost than can be given by any school conducted for profit.

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When you see a man putting in his noon hour learning more about his work, you see a man who won't stay down. He'll never be satisfied until he hits the top. And he'll get there!

In shops, factories, offices, stores, in every line of industry, men are holding splendid positions won through spare-time study with the International Correspondence Schools. To-day they are earning four or five times—yes, some of them ten times as much money as when they started.

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For 32 years the International Correspondence Schools have been training men and women right in their own homes.

Thousands upon thousands of men have stepped up in just this way. More than 180,000 are studying now. Can you afford to let another hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, just mark and mail this coupon!

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WHOLESALE RADIO DISTRIBUTORS
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Physical Spendthrifts

(*Continued from page 155*)

three minutes, whereupon they can again lift eight pounds for a brief period.

In the case of certain unsuspecting individuals we find that, when they can no longer lift eight pounds and they are told that the load is to be changed from eight to seven pounds, a pound can actually be *added*, making a total of nine pounds, yet their work continues quite as if a pound had been removed.

In such cases the mental attitude toward the work, not the actual load on the muscles, is what determines working capacity. The same influence of mental attitude may be shown at the end of the three-minute rest period after the supposedly seven-pound run. If, instead of increasing the load to eight pounds, two pounds are taken off, reducing the load from nine to seven pounds, the subject acts as if the load were heavier!

Fatigue and rest are generally considered to have an important bearing on infection and disease. Until recently, the weary individual was quite universally believed to be more susceptible to infection than the rested man. In experimental tests on rats and guinea pigs, however, we found in my laboratory, to our great surprise, that exhausted animals survived infection more readily than rested animals.

An Unexplained Mystery

No rational scientific explanation of these facts so far has appeared. The results are particularly puzzling when we recall that the first step in the successful treatment of pulmonary tuberculosis is *absolute rest*.

Tubercular men and women are peculiarly prone to fatigue. The slightest work exhausts them. By further experiments now in progress we hope to show the relation between good physical condition and susceptibility to infection.

The practical question arises: Can we increase our physical performance by any means other than the stimulation of our emotions? Physiologists long have been studying exactly what happens, chemically, when a muscle contracts and when it recovers from a contraction.

One fact stands out clearly. In the recovery process of resting, the muscle regains its energy by chemically combining sugar and phosphate. Both sugar and phosphate are normally present in relatively small amounts in the blood. A German physiologist, Gustav Embden, believing that the sugar-phosphate concentration in the muscle could be increased by feeding a sugar-phosphate mixture, recently conducted a series of experiments with soldiers. The results were amazing. In the most striking experiment, one man was able to do 21.5 per cent more work on eight phosphate days than he did on eight days when he had taken no phosphate.

Phosphate does not work with all people, however. Nevertheless, Embden's results suggest that, when properly administered under the direction of an expert, phosphate may prove to be of tremendous practical importance.

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
April, 1924

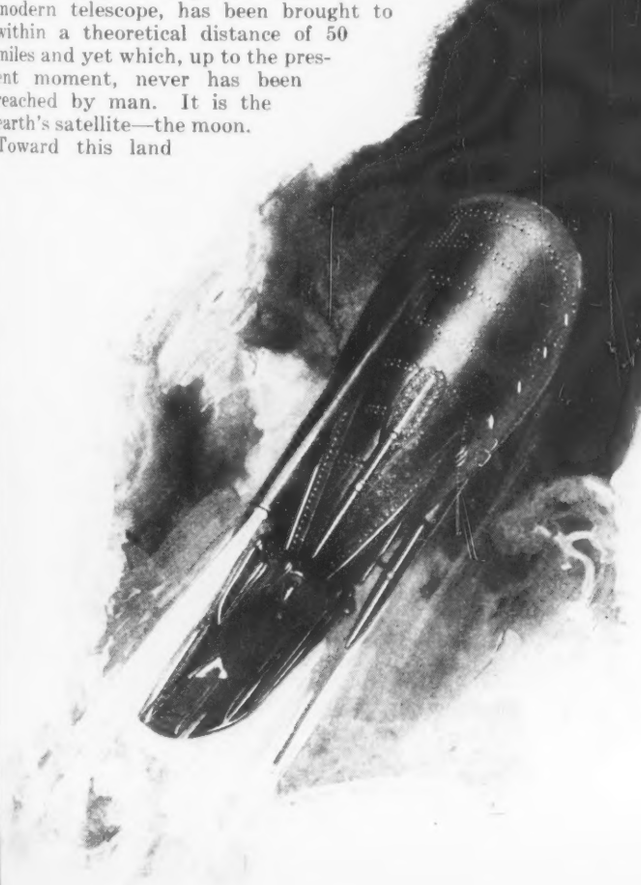
A Rocket to the Moon

By F. Gregory Hartswick

IF THE proposed transpolar flight by airship is completed successfully, almost the last unexplored region of the earth will have been charted and mapped. In the restless wanderings of man over this globe only a few square miles have been left untrodden. The eternal spirit of "something lost behind the ranges" has driven men from time immemorial to seek what lies in the unknown regions.

And now the earth's last hidden territory to the north is about to yield its secrets. Where will the restless force of adventure drive man next?

There is a territory not far away, as distances go in space—a territory explored by the eye of man, mapped, named, and described—a territory that, through the powerful eye of the modern telescope, has been brought to within a theoretical distance of 50 miles and yet which, up to the present moment, never has been reached by man. It is the earth's satellite—the moon. Toward this land the eye of the scientist and explorer has been turning hungrily. And today their indomitable spirit, in the person of Professor R. H. Goddard, of Clark University, Worcester, Mass., plans to hurl into space a rocket that will bridge the 240,000-mile gap separating us from our nearest heavenly neighbor. He plans to make his experiment early in the coming summer.



Years ago Jules Verne told of a hollow cannon ball that carried passengers from the earth to the moon. More recently Professor H. Oberth, of Rumania, suggested the possibility of a passenger-carrying rocket, such as our artist has visualized on this page. Far less imposing and fantastic is Professor Goddard's moon rocket, described in the accompanying article; yet his invention at least is based on a hypothesis of scientific practicability and so has compelled the attention of scientists. Who knows but that his modest attempt to photograph the blazing trail of a missile shot through the vault of heaven may be a pathfinder for future achievements in interworld communication?

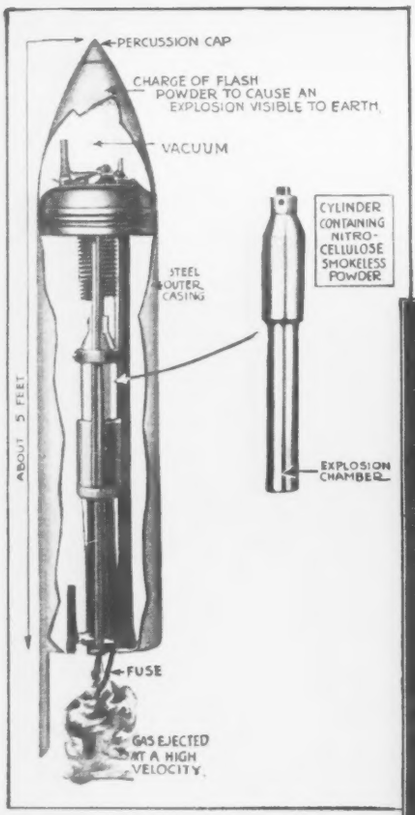
Man, in his own mind, has been traveling to the moon ever since the tellers of tales realized that the ideal field for romance lay in the lunar satellite. All a writer had to do was to invent a suitably plausible method of reaching the moon, and, presto! His hero was safe where the most violently impossible things could happen.

Rostand's immortal *Cyrano de Bergerac* made the trip, according to his own account, by sitting on a piece of iron and throwing a magnet into the air. "The magnet thrown," says the gallant Gascon,

> Infallibly the iron must pursue;
> Then, quick! Relaunch your magnet, and you mount
> Unmeasured distances!

The good *Cyrano's* plan is not to be recommended to possible lunar explorers.

Edgar Allan Poe's *Hans Pfaal* made a successful journey to the moon in a balloon filled with a gas, the



Professor Robert H. Goddard, head of the Department of Physics at Clark University, Worcester, Mass., demonstrating his high-speed rocket that he hopes to shoot to the moon this coming summer. Construction of the rocket is shown in the diagram

formula of which was a dark secret. He found air all the way to the moon—thin but condensible into breathable atmosphere.

Jules Verne sent his heroes flying from the earth in a huge projectile fired from a cannon. H. G. Wells invented a substance called "cavorite," which acted as an insulator to the force of gravity. Standing on a plate of cavorite, you immediately shot off into space at a tangent to the earth, impelled by centrifugal force.

Thus have novelists described their fanciful flights to the moon. But as is so frequently the case with novelists, even the most imaginative have not nearly approached the mark set by practical inventors. In fact, the fictioneer overlooked the most obvious method of shooting a projectile into space. The Fourth of July rocket was to be seen on every hand, yet none thought of it till Professor Goddard, an unassuming university lecturer with no literary leanings, calmly announced that he had perfected a rocket with which he hoped to score a bull's-eye square in the middle of the lunar countenance.

More than Six Miles a Second

Professor Goddard has given his rocket an initial propelling charge of terrific force, sufficient to generate a speed of 6.6 miles a second, or enough, he says, to hurl the rocket out of the field of the earth's gravity.

To keep the rocket going, he has provided a series of successive charges that, exploding in space, by their reaction drive the rocket ahead. Free of the earth's pull, the rocket will continue till the propelling charges are exhausted—a time long enough, Professor Goddard believes, to bring it well within the gravitational sphere of the moon. Gravitation will do the rest, he says, and the rocket will fall headlong into the midst of the lunar world.

The explosive charge first used by Professor Goddard in his rocket experiments was smokeless powder; but he has recently perfected a method of burning liquid in an atmosphere of pure oxygen, a process said to generate an expansive force many times greater than the original charge.

Nor will the Goddard rocket, if it arrives on the moon, be unseen by earthlings. Its course will be carefully plotted and mapped in advance, and the spot of its ultimate arrival calculated with the utmost nicety. Powerful telescopes will be trained on that spot. In the head of the rocket will be placed a heavy charge of flashlight powder with a contact fuse. The flash of impact should be seen from earth, the inventor believes. And his assumption would seem to be reasonable when we consider that the Woolworth Building, if it were on the moon, could be distinguished by our astronomers' most powerful telescopes.

If successful, the Goddard rocket may mark the beginning of an epoch of interplanetary communication. Such a possibility naturally leads to the question, "Is there life on the moon?"

Concerning this subject dispute has long raged. It must be admitted that the advantage of argument lies with the school that holds that the moon has no atmosphere, therefore no life. The shadows cast on the moon are sharp and hard, not dulled as they would be by an atmosphere. In all telescopic investigations nothing has been discovered to indicate any organized life activities. On the other hand, Professor W. H. Pickering, noted American astronomer, thinks that there are distinct signs of volcanic activity on the moon's surface. He also believes that he has detected a thin atmosphere—even an occasional light fall of snow. There must be a moisture-retaining soil, he thinks, and life may exist under the most trying conditions.

The temperature of the moon is also a moot point. The practical absence of atmosphere would allow the direct penetration of the sun's rays; but it also would allow direct radiation. The moon may be, during its 14-day "day," either well above the boiling-point or far below freezing.

It would be necessary for the hardy explorer of the heavens who may follow the wake of the first experimental moon rocket to be well protected against extremes of heat and cold. As for air, Professor Goddard says: "That is a problem similar to that of the submarine." He points out that if man can live for a long period under water, he could exist, at least temporarily, in a partial vacuum; and if his clothes were of sufficiently high insulating quality, he could easily endure the moon's possible sharp changes of temperature.

Is There Life on the Moon?

And what life, if any, would the explorer find on the moon? Once more speculation enters. Professor Pickering thinks that life on the moon is probably of a low form of vegetation, existing in hollows where the atmosphere is heaviest. Professor Goddard himself disposes of the theories of many romancers concerning inhabitants of the moon by saying, "I don't believe that, under the physical conditions of the moon as we know them, the form of life would be higher than ours." And there remains the fact that at no time has there been evidence of activities at all approaching those of our own planet. If there were cities, we should see them.

Yet there is another possibility, hinted at by H. G. Wells—the possibility of a life carried on in vast caverns beneath the moon surface, where the atmosphere would collect in its densest form and where the bitter cold or suffocating heat would be tempered to a bearable degree.

What sort of creatures might be found there? Certainly their life would be far different from ours; for the gravitation of the moon is far less than ours. We could lift enormous weights on the moon, leap 40 feet at a stride, jump 10 or 20 feet into the air. The moon's inhabitants, if such exist, would have excessively developed lungs to live in rarefied atmosphere; their ears would have to be large and sensitive to distinguish sound vibrations transmitted through the thin air. Indeed, they might have devised some system of communication that makes no use of sound—signs, perhaps, or a tactile sense highly developed, as is the case with the ants, or some intricate human radio.

All this, of course, is entirely in the realm of fantasy. But if Goddard's rocket is successful, before long fantasy may be replaced with scientific facts.

Motorized Rapid Transit in the Far North

THE march of science into the frozen expanses of the Far North is bringing a new era of rapid communication across the wildernesses of snow. Mail planes equipped with landing skis, and swift, motorized sleds soon may replace the picturesque dog teams, just as the motor car is replacing the camels of the desert. Our artist has pictured above these possibilities of arctic rapid transit.

The United States Post Office Department recently announced plans for airplane mail service from the terminus of the Government Railway at Nenana, Alaska, to Fairbanks. Thus a 20-day delivery service by dog team will be supplanted by a four-hour air mail service.

At the same time an ingenious motorized sled has made its appearance at Helsingfors, Finland. The machine is propelled by a motorcycle engine belted to a bicycle wheel. The contact of the rubber tire with the snow is said to create sufficient friction to drive the sled forward.

Broncho-Busting the Wild Colorado

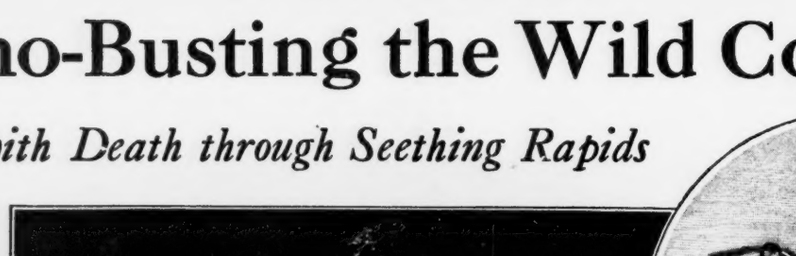
A Race with Death through Seething Rapids

By George Dacy

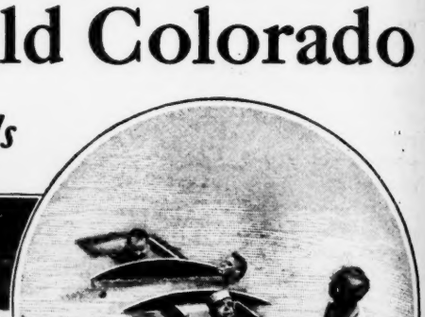
SCIENCE has stormed successfully the last bulwark of Nature in the United States.

A few weeks ago an exploration and surveying party of the United States Geological Survey, headed by Col. C. H. Birdseye, completed the work of surveying and mapping the Colorado River through the Grand Canyon—a 450-mile swirling stretch of the wildest water in the world. Though the mapping of the Colorado has been in progress since the days of Abraham Lincoln, those who previously ventured into this portion of the river had been frustrated in their attempts to survey it. Few daring explorers had navigated it successfully.

Ten men made up the recent surveying party—one of the nine who started being replaced by another during the trip. In the 78 days required to accomplish the mission, Death almost constantly reached out from the mad white waters to seize their boats and hurl them to destruction against the jagged rocks.



Uncle Sam's engineers making a plane table survey while the "white water" rushes about them. Despite difficulties of setting instruments, the survey of the river was completed



One reason why the hazardous expedition was successful—the specially designed boats were unsinkable, and the passengers eventually learned to accept ordinary disasters such as this as something to laugh at

MORE than 6,000,000 horsepower —equal to half the electric power in the country today—is constantly going to waste in the wild, unbridled waters of the Colorado River through which Col. C. H. Birdseye and his party of government surveyors made their mad dash of exploration.

It was to pave the way for the capture and use of this tremendous power, as well as for the development of a vast territory by irrigation and cultivation, that the government explorers braved unknown canyon depths.

Their achievement is far more than a thrilling adventure. It is an important contribution of scientists to the development of America's natural resources.

A Racing, Rioting Torrent

Imagine the fury of a Niagara concentrated in a narrow winding channel cut through solid rock that rises a quarter to half a mile in the air, and you will have a faint idea of the racing, rioting torrent on which the explorers rode with the speed of an arrow. Yet beyond their breath-taking adventures, the scientific value of the exploration is paramount in interest.

Millions of horsepower constantly are going to waste in the tempestuous waters of the Colorado. California and Arizona have in project dozens of irrigation schemes, the potential success of which is entirely dependent upon the harnessing of the river to the needs of modern civilization.

Corraled and subdued to the service of man, this wild-flowing stream would supply Los Angeles with a constant source of power, insuring the industrial future of the city. The copper mines of Arizona, containing some of the richest copper deposits in all creation, and now operated by steam power developed from oil burners, could increase their yield immeasurably.

Uncle Sam's expedition just completed blazed the path that eventually must lead to these accomplishments. From the standpoint of science and of the industrial advancement of the Far West, a most important part of the explorers' work was the surveying of 20 sites suitable for large power dams on the 450-mile course where the Colorado rages most fiercely and runs most swiftly.

The uncharted stretches of the Colorado had been a thorn in the side of the Geological Survey for more than half a century, and Uncle Sam decided upon a supreme effort to conquer them. Four specially constructed wooden boats and one canvas canoe were mobilized for the expedition, for an ordinary rowboat in those turbulent waters would have survived about as long as a paper craft would in a millrace.

This boat has been hauled high up the banks and lashed to the slope to prevent its being swept away by a sudden flood that caused the Colorado River to rise 21 feet in one night

Next, daring, seasoned men were selected for the party. Besides Colonel Birdseye were E. C. LaRue, a hydraulic engineer, who for several years had been studying the problem of utilizing the waters of the Colorado; R. C. Moore, state geologist of Kansas, R. W. Burchard, a Federal topographical engineer, who previously had surveyed the lower stretches of the river; Emery C. Kolb, of Grand Canyon, an expert boatman; L. R. Freeman, explorer and boatman of California; two more boatmen, and a cook.

The rigors of the extraordinary journey began as soon as the party left the railroad at Flagstaff, Ariz. Thence the equipment was carried by motor truck 140 miles over some of the roughest roads under the sun. Lees Ferry was the take-off point of the perilous river trip. A radio receiving set was carried—the party's only means of keeping in touch with the outside world.

Lifelines in Daily Use

One skilful boatman guided each boat through the churning rapids. Each boat usually held three men. Clad in life jackets made of cork and provided with kapok collars, the passengers resembled aviators fully equipped for a dash into freezing altitudes. They lay face downward in the boats, clinging tightly to the lifelines that were stretched across the decks.

During the entire journey the scientists of the party carried on surveying and explorative work. Of course, they did not make a chain survey of the river; but by a trigonometrical system well known to the surveying fraternity, they were able to

gage and map even the most furious stretches of the river.

Plane-table readings were made along the banks at points from 600 feet to half a mile apart. Where the canyon walls rose straight and sheer, the surveyors had to exercise the sure-footedness and agility of mountain goats to make their sights.

One day the boats came upon a mammoth boulder, 80 by 40 feet in thickness, towering 30 feet above the normal waterline and exactly in the middle of the river. In a violent swirl near this giant rock, one of the boatmen, born and reared in Hawaii, upset the canvas canoe. Trained in the exciting water sports of his native land, he was not disconcerted by this mishap. Not only did he survive the fury of waters that would have overwhelmed the ordinary swimmer, but he also rescued the canoe. In the full course of the violent current, he righted the craft, boarded it, and sped swiftly to the next camping place. A few days later this canoe was lost in an attempt to "line" it around Spring Cave Rapids; that is, to drag it around by means of lines attached to the bow and stern and handled from the overhanging cliffs.

Boats Tossed High in the Air

The boatmen were constantly performing circus-like feats. Colonel Birdseye tells of one of these incidents. "In the Boulder Rapids one day," he says, "one of our boatmen was hurled bodily from his craft when the backflow of high waves caught his boat and tossed it into the air like a ball bounding from a tennis racket. The boatman turned a complete somersault, then disappeared beneath the water. He was an expert swimmer, though, and he pursued and captured his runaway craft, climbing aboard while the boat bucked like a wild horse."

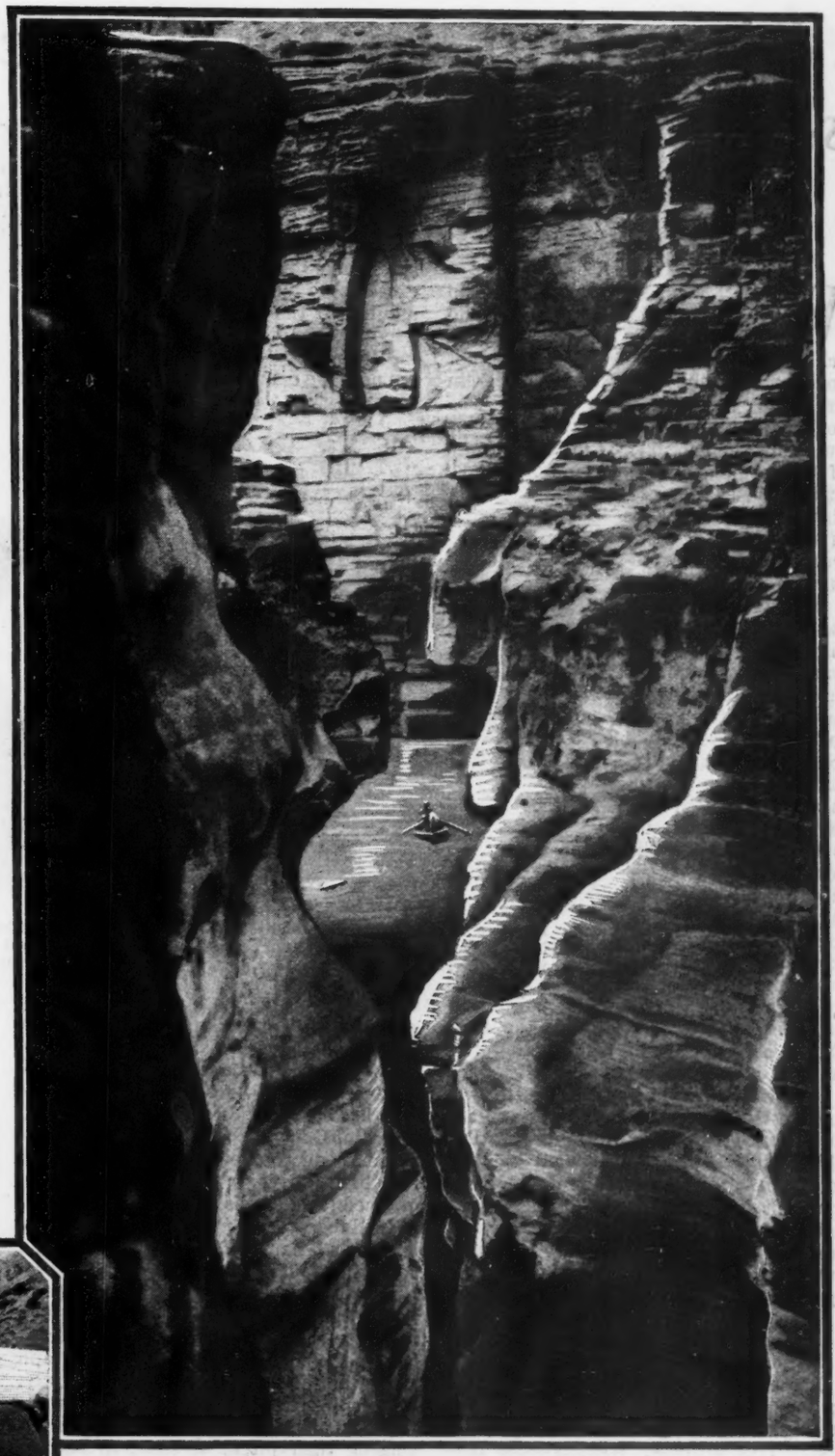
After heavy rains, the Colorado River sometimes rises very rapidly and without warning, as the water flows from the upper stream into the canyon.

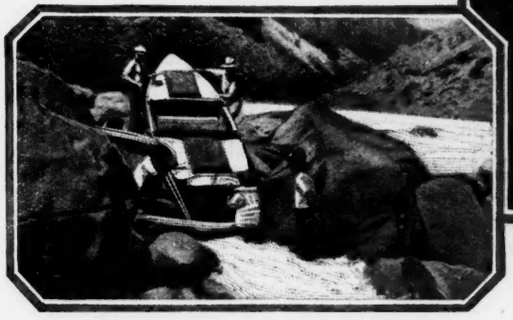
"One night," says Colonel Birdseye, "we noticed that the water had begun to rise suddenly, endangering our boats, our provisions, and our lives, for we were in a narrow, boxlike canyon, with steep sides that afforded no foothold. With block and tackle we dragged the cook boat and provisions high up on the side of the cliff. With difficulty the other boats were run downstream to a place of safety. There the boatmen remained all night, every few hours dragging their boats still higher up the banks as the river rose.

"By the next morning the river had risen 16 feet, and it continued its upflow until it reached a peak point 21 feet above the waterline. When we returned to civilization, we learned that the world had believed us lost during this flood, an opinion that seemed to have been confirmed by the fact that airplane searchers were unable to find trace of us."

At Separation Rapids at the mouth of a deep canyon, where three members of a former national expedition down the Colorado were killed by Indians, the waters have a fall of 20 feet. They must be dared in boats, since sheer walls make it impossible to attempt a portage. One of the boats of the recent expedition was tossed high in the air in running these dangerous rapids. When it came down bottom uppermost, its three occupants were hurled into the water.

The explorers managed to rescue their unfortunate companions, but not until one of them had been almost crushed to death against the rocks. During the whole trip only one man was severely injured.





One of the majestic gorges of the Grand Canyon of the Colorado, where the sky appeared as a narrow slit between towering walls. Notice one of the surveyor's boats on the river, framed by the jagged cliffs. The picture at the left shows the surveyors skidding a boat over the rocks at the head of Soap Creek Rapids—a hazardous task

Listening In for Insect "Voices"

Supersensitive Microphone Designed to Perfect Radio Broadcasting Holds Fascinating Possibilities for Scientific Research

By Donald Harris

WHEN you listen in on the radio to a violin selection or a piano solo, your ears and your memory tell you that what you hear does not sound exactly like the tones of any violin or piano you ever have heard. The sounds that come to you through your headset or loudspeaker *approximate* those of the instruments, but you would have little difficulty in distinguishing the sounds of a real violin or piano from the radio reproduction.

The scientific reason for this is that the microphones used in transmitting the radio programs are not sensitive enough to respond to the more rapid sound vibrations produced by the instruments and voices of the performers. The result is that over the radio you do not hear all the vibrations of most musical and voice tones, and consequently you do not hear their true tones. The same is true of a telephone. Familiar voices will sound strange to you because the telephone is incapable of transmitting the more rapid sound vibrations.

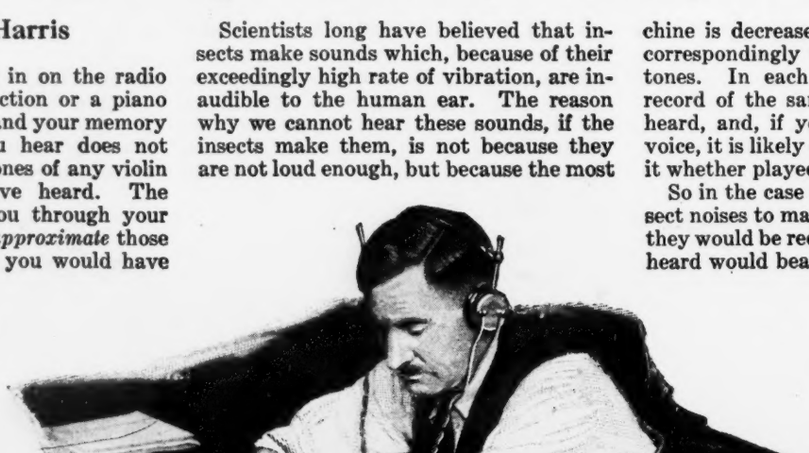
Recently, however, in the laboratory of the Westinghouse Electric and Manufacturing Company in Pittsburgh, Dr. Phillips Thomas perfected what he calls an "ultra-audible microphone," an instrument said to be capable of picking up sound waves of almost every conceivable rate of vibration, from the very lowest to those that are far too rapid to be detected by the human ear.

Perfect Radio Reproduction

The prime purpose of this invention is to make possible perfect radio broadcasting to achieve perfect radio reproduction. This purpose, Westinghouse officials say, has been achieved—at any rate, from the broadcasting end. That is to say, broadcasting studios, using Doctor Thomas' invention, now can put perfect music in the air. To reproduce it, though, with equal excellence, naturally requires a receiver of equal sensitiveness. Such a receiver is not included in the equipment of the ordinary radio fan, but Westinghouse experts say it will be eventually.

In addition to its utility for radio, the fact that the new microphone seems capable of receiving sound vibrations within a range that may be limitless has led its inventor and other scientists to believe it may be used in the study of the sounds made by insects.

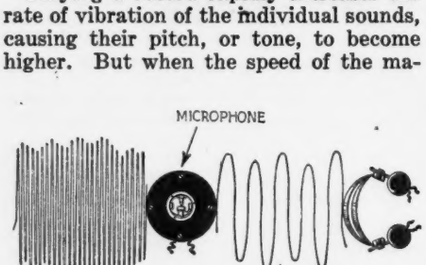
Scientists long have believed that insects make sounds which, because of their exceedingly high rate of vibration, are inaudible to the human ear. The reason why we cannot hear these sounds, if the insects make them, is not because they are not loud enough, but because the most sensitive ears are incapable of detecting sounds with a rate of vibration more than 20,000 a second. This, scientists believe, is many times less than the frequency of the insect sounds.



Listening in on a moth—Dr. Phillips Thomas using the ultra-audible microphone invented by him in an effort to perfect radio broadcasting and to determine whether insects "speak" in sounds the pitch of which is too high for human ears

It has been suggested that insect sound vibrations might be picked up by the Thomas microphone, then transformed into light waves, which could be photographed for analysis as frequently is done in the laboratory. Or the sounds that are inaudible because of their rapid vibration could be transformed into sounds of proportionate vibration within the range of the human ear. This second method might be compared with the same modification of sounds heard when a phonograph record first is played rapidly, then slowly.

Playing a record rapidly increases the rate of vibration of the individual sounds, causing their pitch, or tone, to become higher. But when the speed of the machine is decreased, the rate of vibration correspondingly decreases, causing lower tones. In each case, however, it is a record of the same singer's voice that is heard, and, if you are familiar with the voice, it is likely that you would recognize it whether played slowly or quickly.



This schematic diagram shows how the sensitive new microphone eventually may be used to translate high-frequency sound waves beyond the range of human ears, into audible low-frequency waves of the same characteristics, thus detecting insect "voices" if they exist

So in the case of the modification of insect noises to make them audible. Though they would be reduced in pitch, the sounds heard would bear an exact relation to the original sounds.

Of course, scientists until now only have been able to speculate as to whether insects that do not make audible sounds actually make any sounds at all. Similarly, scientists do not know whether insect sounds, if they are made, represent a method of communication, or whether they are merely accidental and meaningless, like the sounds made by a man's arms brushing his sides as he walks.

The investigation of these mysteries of the insect world offers fascinating possibilities from the standpoint of the scientist. That is why the new microphone has aroused much interest among entomologists.

The ability to hear hitherto inaudible insect sounds, though, does not necessarily mean that man ever will be able to read any meaning from such noises. In fact, scientists say such a possibility is most unlikely. In this connection they point out that we have been hearing the voices of birds, animals, and the larger insects for centuries, yet we are unable to interpret them beyond recognizing cries that betoken fear, anger, or pleasure.

How the Sounds Are Detected

The ultra-audible microphone is a highly complex instrument and at present is virtually useless except in the hands of one who is expert in its operations. It consists of a ring of insulating material in which two small electrodes are inserted, exactly opposite each other and separated by only a few millimeters. Direct current of high voltage is applied to the electrodes, causing a "glow-discharge" in the gap. This is neither a spark nor an arc, but a streak of soft, purplish light.

As sound waves impinge upon this glow, it vibrates in sympathy and the flow of current to the electrodes varies correspondingly. The current variations cause the diaphragms in a pair of ear phones to vibrate, thereby reproducing the sound, just as vibrations of the diaphragm in an ordinary telephone receiver reproduce the sounds uttered in the transmitter.

Emotions—the Fuel of Life

Fourth Article in "The Story of the Mind"

By James J. Walsh, M.D., Sc.D.

IN A small city of the Middle West that I have occasion to visit now and then are two drug-stores.

One of them has been established for many years. Its proprietor is an excellent pharmacist. That I know from experience. The other is a new store—about three years old. Its proprietor is not a pharmacist. Probably he could not compound a simple prescription if his life depended on it. The prescriptions that are brought to his store are filled by an assistant, a registered druggist.

And yet the newer store is the more successful, so much so that when I visited the city last, I was informed that the owner of the older store was on the verge of bankruptcy because his new competitor had made such heavy inroads into his trade. What was the reason?

The secret was this: The proprietor of the older store is a sour, silent man—a "grouch" to express it popularly—and his store is like himself—dingy, ill-lighted, and undecorated except by unsightly shelves of chemicals. The owner of the new store, on the other hand, is affable, smiling, dapper; polite to his customers; ready, apparently, to go to any extreme to serve them. People who enter his store feel a warm glow of friendliness, in striking contrast with the depressing effect on them of visiting the other store.

A business expert, no doubt, would attribute the success of the new store to superior merchandising methods. To a psychologist, however, the explanation is immensely more simple. It rests on an elementary but highly important psychological principle—the power of emotion.

What Emotion Is

An emotion is a state of mind that prompts to action. Love, hate, joy, sorrow, and anger are emotions. Hunger, thirst, pain, and similar bodily feelings are not emotions, although they may lead to emotions. Similarly, emotions are invariably accompanied by bodily feelings, and, unless repressed or hidden by action of the will, are displayed by such outward signs as blushing, trembling, weeping, laughing, and movement of the face muscles. The voice is generally affected, and frequently the mouth, eyes, and nose and the heart and other vital organs.

Professor William James, of Harvard, stressed the fact that a disembodied emotion is an impossibility. Yet emotions must be considered apart from all bodily feelings or manifestations and must not be confused with ideas, for ideas merely find their way into the mind without prompting to action.

Thus, in the case of the two drug stores, the emotion of dislike inspired by the cheerless atmosphere of the older store led its former customers to take their trade to the newer store, where brightness, cheerfulness, and attractive decorations supplied the impetus that caused the brain and nervous system to react with the emotion of good feeling that makes spending easy.

Why You Like and Dislike

Similar instances are everywhere about you. Meeting some people for the first time, you instinctively like them. Other people you dislike even before you have spoken with them. Certain streets and certain cities have a depressing effect on you, while others inspire you. Your thoughts and feelings are quite different in a church during a funeral service and during an Easter service. In each case your emotions are being stirred.

One of the most successful lawyers I know bears the reputation of knowing very little law. Yet his ability to win apparently hopeless cases in jury trials is proverbial in the city where he practises.

© Ewing Galloway

Anger rules momentarily by imparting fear. This picture shows Governor Peter Stuyvesant, in an outburst of anger, destroying the British summons to surrender New York in 1664

He possesses a highly developed sense of dramatic effect, and in the cases he tries, he stakes everything on an appeal to the emotions of the jury. He realizes the important psychological principle that the emotions are a more potent moving force than reason or logic. They are elemental. They are ingrained in the very fibers of man.

"The emotions," states Dr. Carl George Lange, distinguished psychologist, of Copenhagen, "are not only the most important factors in the life of the individual, but they are also the most powerful forces of nature known to us."

Courtesy Metropolitan Museum of Art

The most powerful of all human emotions—the love of a mother for her child—is portrayed in this fine painting, "The Vintage," by L. Lhermitte. Such an elemental emotion, says Doctor Walsh, is a more potent force than reason or logic, and can rise supreme over bodily feelings and over man's greatest terror—the fear of death

Man's Greatest Terror

No one who considers the vital influence of emotion even in every-day affairs will hesitate to subscribe to this opinion, for the emotions triumph over bodily feelings—hunger, cold, pain, fatigue, and illness; and a powerful emotion, such as love, can rise supreme even over man's greatest terror—the fear of death.

On love, an emotion of wide character that manifests itself in many diverse ways, is based the familiar rule, "women and children first," at time of disaster at sea. When the *Titanic* went down, men stood calmly by, knowing that they were inevitably doomed to death, to permit the women and children passengers to be saved. It was an emotion of chivalric regard for women, traceable

Courtesy Metropolitan Museum of Art

Fear, the universal emotion, is written on the faces of the wounded poacher and his son in Karl Wilhelm Hubner's painting, "The Poacher's Death." Father and son, driven by terror of the approaching landowner and gamekeeper, are making a superhuman effort to reach their cabin. The terrified son, his right arm supporting his father and his left extended to the door latch, is straining every muscle and nerve to drag his father to safety. The painting is a striking portrayal of the power of fear to drive the human body

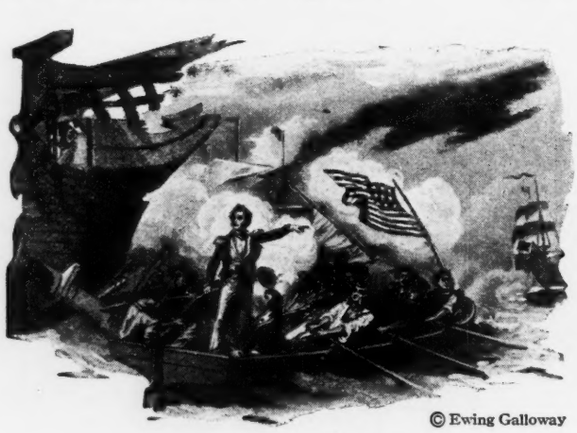
probably to the age-old love of a son for his mother, that braced them for this. On the other hand, the love of some of the women for their husbands so strongly influenced them that they chose to perish rather than be saved without them.

Countless instances might be recounted of the emotion of love manifested as patriotism, or love of country, inspiring the most sublime heroism on the battlefield.

Beside the emotion of love may well be placed the emotion of hate. This is an emotion that has a very deep hold on humanity, proving at times a source of energy that enables people to make almost superhuman efforts. I have heard it said that a famous banker of other days owed all his success to his desire to be revenged upon another banker who affronted him early in his career. What degree of self-satisfaction his success brought him I have no way of knowing, for hate is by no means so lasting an emotion nor so strong an influence as love.

Still, it is remarkable that people frequently will be drawn together much more strongly by mutual dislikes, even in such trivial matters as dislike for certain foods, than by mutual likes. This propensity of mankind was well expressed by the man who nominated Grover Cleveland as a candidate for President with the slogan, "We love him for the enemies he has made."

Success in life, especially in any active calling, almost invariably depends upon ability to stir the emotions of others while maintaining rigid self control. Executives control others more frequently through some degree of such emotions as love or fear than through reason.



© Ewing Galloway

Supreme courage is typified in Commodore Perry who, though forced to leave his shattered flagship, won the Battle of Lake Erie from the British. This painting is by W. H. Powell

I know the head of a vast manufacturing enterprise whose knowledge of the technical processes of his factory is almost nil. Yet his organization is one of the strongest in the country. None of his employees or associates ever thinks of questioning his decisions or of opposing him, even though their knowledge of some details of the business may be greater than his. That is because he possesses the gift of stirring their emotions. They love him for his fairness and integrity, they respect him for his ability as an organizer, they find his enthusiasm contagious, and they give him their best work.

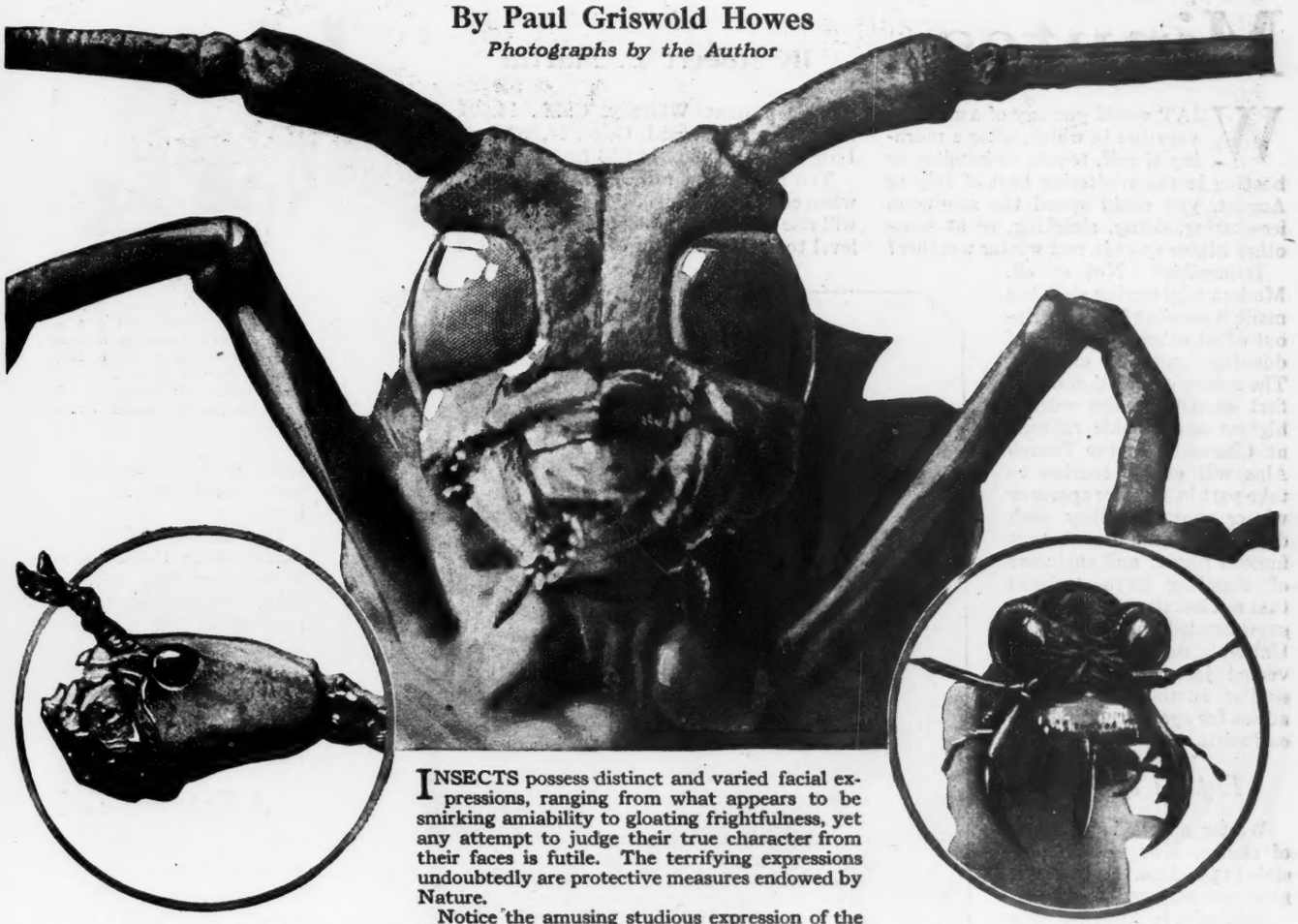
An opposite type is a man who operates a concern equally large. He has come up through the ranks and knows the details of his business far better than any of his employees. But he is inclined to be overbearing and even unfair with his subordinates. Yet his business is on a firm foundation, is eminently successful and his employees work with all their energy. This man rules through fear, one of the most potent of all emotions, yet one that has many unfortunate reactions.

The old copy-book maxims that advised young business

(*Continued on page 131*)

Odd Faces from the Insect World

By Paul Griswold Howes
Photographs by the Author

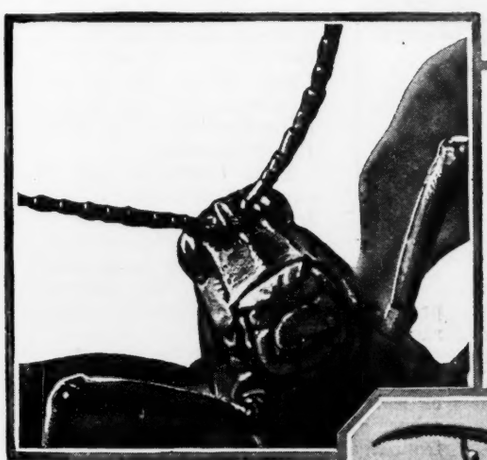


The disposition of the bulldog-like Phyllium mantis of India fits its features. It is as ferocious and bloodthirsty as it looks

INSECTS possess distinct and varied facial expressions, ranging from what appears to be smirking amiability to gloating frightfulness, yet any attempt to judge their true character from their faces is futile. The terrifying expressions undoubtedly are protective measures endowed by Nature.

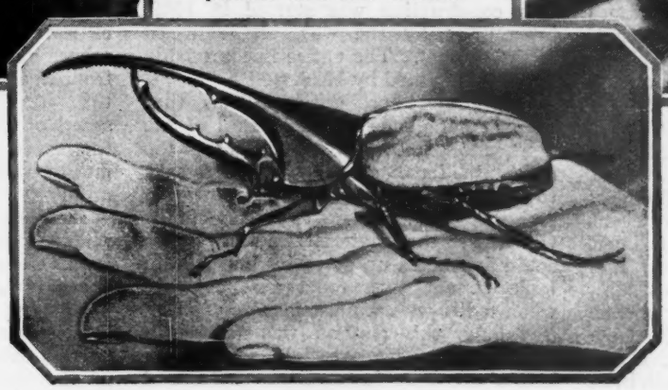
Notice the amusing studious expression of the Batocera beetle of Japan, shown above, with its wide forehead and huge goggles. Like most insects, this beetle has compound eyes with which it sees things in mosaic patterns

The tiger beetle looks all that its name implies. Its mandibles resemble huge fangs, while its great wide eyes inspire terror



What appears to be the mouth of this grasshopper is formed by joints in its armor which, in overlapping, produce characteristic lines and indentations. The actual mouth is below the "chin." Nevertheless, the false mouth serves to give many grasshoppers distinct facial expression. The high forehead would classify this insect as a "highbrow"

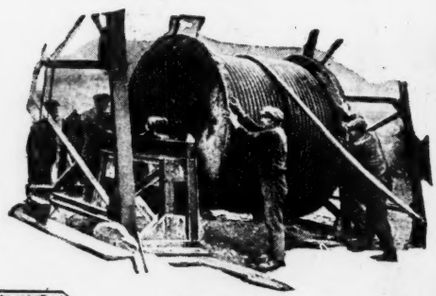
Quite harmless, in spite of its threatening claws, is the great horned Hercules beetle of the West Indies, shown below. Its lobster claws, intended only to frighten its enemies, cannot be opened. Its unusual size alone, as shown in comparison with the hand, would serve to keep most persons at a safe distance



The common dragon-fly or darning-needle is all eyes and mouth. Its chin is decorated with a fringe of "Weary Willie" whiskers, and its face is everlastingly wreathed in a smile. Yet all this apparent good nature is false; for there probably is no more vicious destroyer of its fellow insects than this bloodthirsty bearded glutton

Summer to Winter in Forty Minutes

By Robert E. Martin



Workmen paying out one of the great cables used in constructing the world's highest aerial railroad at Chamonix, in the French Alps. The carrier cable, the largest of all, weighs about 12 pounds a foot

WHAT would you say of a summer vacation in which, after a morning of golf, tennis, swimming, or boating in the sweltering heat of July or August, you could spend the afternoon ice-skating, skiing, sleighing, or at some other winter sport in real winter weather?

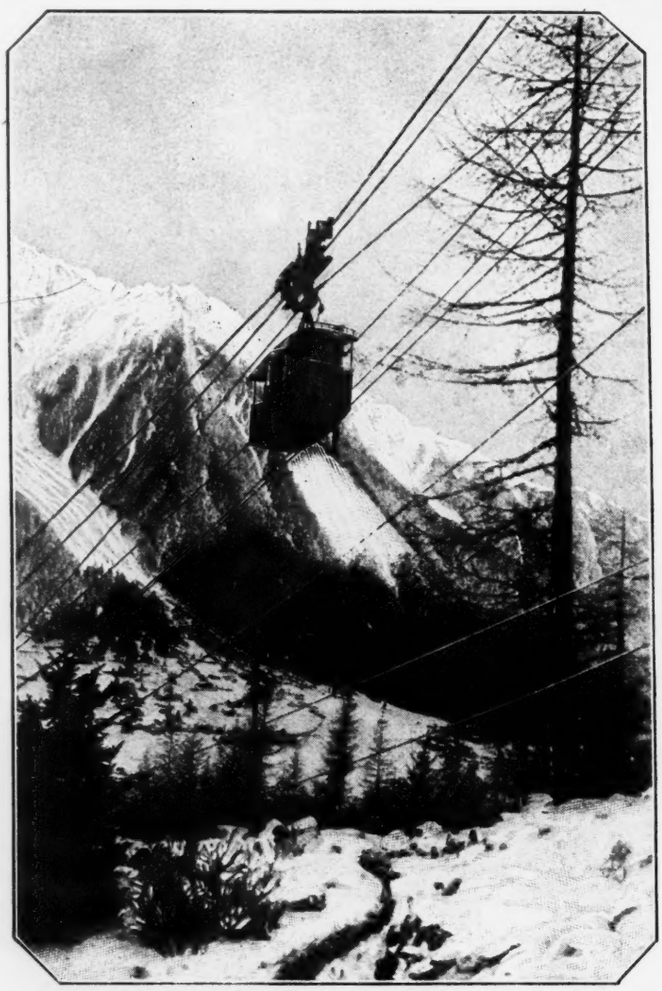
Impossible? Not at all. Modern engineering skill has made it possible for you without effort other than that of donning suitable clothing. The recent completion of the first section of the world's highest aerial cable railroad at Chamonix in the French Alps will enable tourists to take part in summer sports or winter sports as they wish during the summer at that famous resort; and engineers of standing have declared that not less than a half-dozen snow-capped peaks in the United States might be converted just as readily into similar summer-winter paradises for sportsmen and vacationists.

Enjoyed by Few

Winter sports in summer, of course, always were possible in the Alps. Few people, however, enjoyed them.

Similarly, in America, only a handful of venturesome tourists each year dare attempt an ascent of the mountains capped with ice and snow through all seasons. With a cableway, however, any one who desires may sit in a car and be carried to the snow country with no more inconvenience than would be experienced on a short railway journey.

The first wide use of the French cable road came during the recent competition in winter sports at the Olympic Games, when the cableway successfully carried spectators, competitors, and equipment to and from the field of sports.



An aerial cable car of the Chamonix cableway carrying passengers from summer playgrounds to winter sports high in the French Alps

Americans who witnessed the games were impressed by the possibility of building similar cable roads on several of the mountains in the western part of the United States, among them Mount Shasta, Calif., 14,380 feet high, at whose base is Shasta Springs, a well-known health resort; Gray's Peak, Colo., 14,341 feet, 20 miles from the city of Boulder; Pike's Peak, Colo., 14,110 feet, adjacent to Colorado Springs; Mount Rainier, Wash., 14,408 feet, near Seattle and Tacoma; Mount San Bernardino, Calif., 11,600 feet, 25 miles from San Bernardino and a little more than two hours' ride from Los Angeles; Mount Hood, Ore., 11,225 feet, near Portland. Other possibilities include Mount Whitney, Calif., 14,501 feet; Mount Harvard, Colo., 14,399 feet; Long's Peak, Colo., 14,255 feet.

The suspension railway at Chamonix, when completed, will be 3½ miles long and will rise from a point 3250 feet above sea level to the Aiguille du Midi, of 9100 feet altitude, only 3900 feet lower than Mont Blanc, three miles away. At some points the cars must ascend grades of 72 degrees. The construction was started in 1909, interrupted by the war, and resumed again in 1922. The entire line probably will be completed by 1926.

The project presents problems that challenge the ingenuity and skill of the engineers. To move materials up the mountain, for example, it was necessary to construct a temporary cableway on arches of wood. Wherever possible, paths were cut so that materials and machinery could be carried up by mules, but since a mule cannot turn on these pathways when laden with a burden more than 12 feet long, this method was necessarily limited. Some pieces weighing more than half a ton were fastened to cables and dragged up the mountain by detachments of 50 men or more.

One section of the crew would carry the cable over their shoulders, while another would aid them by hauling at the end of the cable which was run through a pulley. On one occasion it required 10 days to move a transformer less than 150 feet by this method over snow-covered ground.

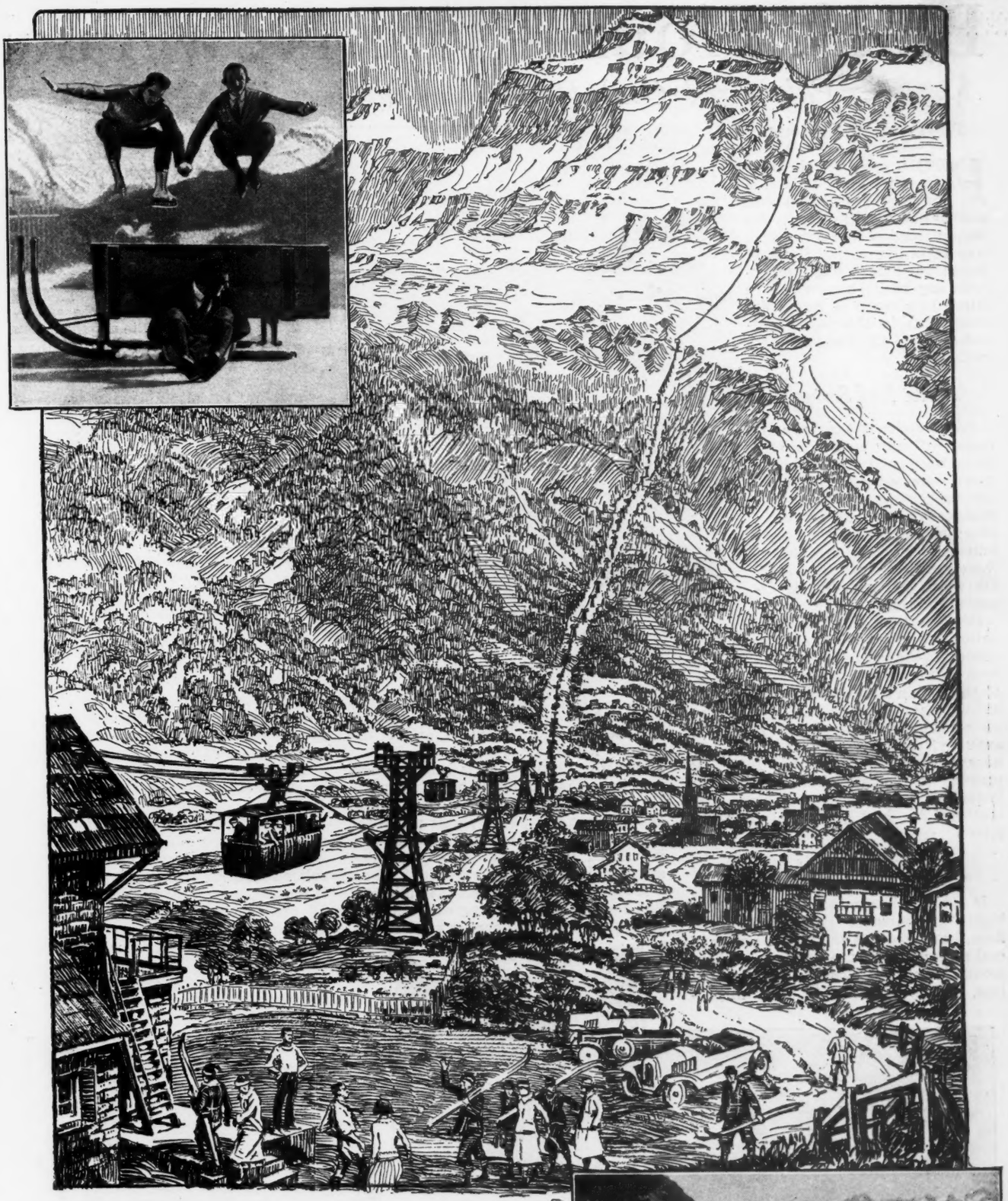
A Staggering Task

The transportation of the cables likewise was a staggering task. The largest cable used — the carrier — weighs about 12 pounds a foot, and a roll of about 400 feet with its special carrier make a weight of 24 tons. Blocks were constructed of masonry on the steepest slopes to facilitate the raising of the cable. To these motor trucks were anchored, their engines operating windlasses that hauled the great coils.

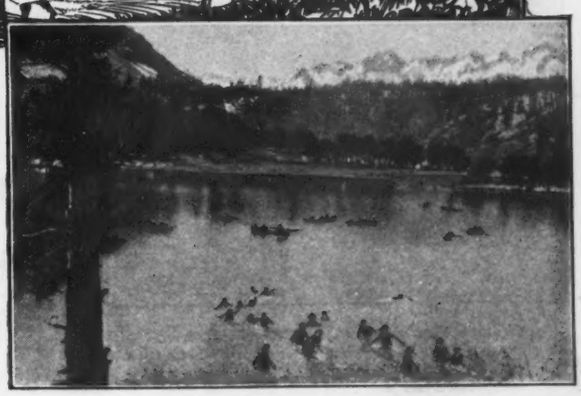
Steel towers support the cables, these varying in height from 39 to more than 100 feet, exclusive of their foundations, according to the profile of the slopes. The towers are protected against avalanches by immense ramparts.

Two cars, each containing seats for 18 passengers, are run on the new section of railway. One car ascends while the other descends. They are suspended from the carrier cables a little more than 12 feet apart, and travel at a speed of about five miles an hour. At this speed the 3½-mile trip from summer to winter can be made in about 40 minutes.

Each car, of course, travels on its own rail and has a separate guide cable, which runs through a ring in the carriage and prevents the car from swaying in the wind. Two other cables—a tractor cable and a brake cable—are used by both cars. The tractor cable is endless, and is operated at the upper station by pulleys and a



The summer-winter paradise for vacationists, as sketched by one of our artists. Aerial cable cars that climb the snow-capped peaks make possible the transition from golf, swimming, and boating in the morning, to skating, skiing, and other winter sports in the afternoon. The construction of this cableway in the French Alps, engineers say, has demonstrated the feasibility of the plan for famous mountain playgrounds of the United States



windlass driven by a 70-horse-power electric motor. At the lower station it passes around another pulley, which enables it to run back.

The brake cable likewise is endless. This passes through a series of steel jaws in the upper carrying chassis of each car. Should the tractor cable break, the car would brake itself by its own weight, the jaws biting into the brake cable and causing the car to descend at a moderate speed.

Black Flour—The New Fuel

Pulverized Coal Piped into Furnaces like Gas

By Truman Stevens

PIPING coal from the mine directly into industrial furnaces, as electric power and gas now are delivered from a central station to consumers, may seem like a wild flight of fancy; yet that is what fuel experts say may be seen in the future as a result of recent developments in the use of pulverized coal—the world's newest fuel.

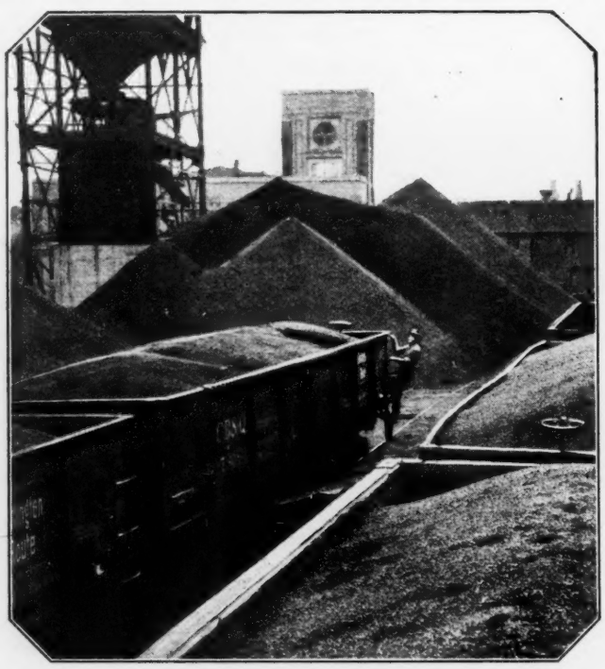
Great Fuel Saving

Conservation of America's coal resources, estimated by John Hays Hammond at 4000 billion tons; increased power efficiency for each ton consumed and therefore greater industrial economy; elimination of the smoke nuisance in industrial centers—these are other important benefits which the new fuel is expected to bring.

Of these possibilities, conservation and economy are of vital interest to the consumer. It has been estimated that one third of the nation's high-grade coal already has been mined. We now are consuming about six tons per capita annually, as compared with the 3.6 tons burned for each inhabitant in 1900. At present the industries of the country, including railroads, are taking nine tenths of the best grade coal from the mines.

May Reduce Coal Prices

If industry in general, by utilizing the highly inflammable pulverized "black flour," can consume the poorer grades of coal represented in the culm piles—those mountains of discarded coal dust, screenings, and slag familiar to every mine—experts believe that the domestic grades will become more plentiful and consequently less costly.



Coal screenings, of little commercial value heretofore, are declared to be ideal for making the new pulverized fuel. Above are shown great piles of screenings for use in firing cement kilns

Already the new fuel is being used in two important branches of industry—in the firing of rotary cement kilns, and in electric-light and power plants where the constant rate of heat produced by the pulverized fuel is said to be a decided asset.

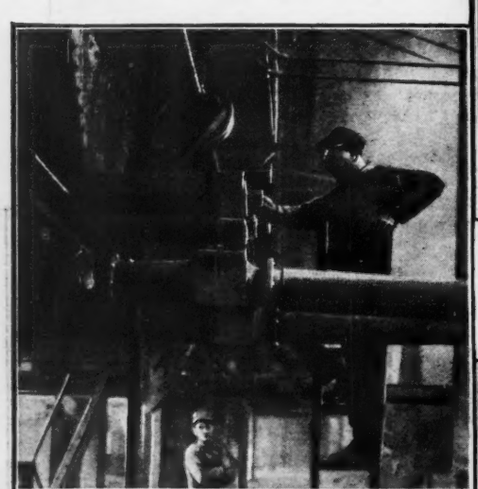
A few weeks ago engineers at Fullerton, Pa., succeeded in pumping coal that had been ground fine as flour for more than a mile through a five-inch pipe line. The tests were made on a system actuated by a revolving screw pump that starts the coal mass in motion. At the discharge of the pump, the mass is rendered semi-fluid by aeration with a number of small streams of compressed air. These streams carry the coal along, largely in suspension, to the point of discharge of the pipe line. Thus the area over which coal powdered at a central plant may be used is greatly extended. Central pulverizing plants supplying a number of boiler plants become a practical possibility, without the necessity of cars for moving the coal from pulverizer to boiler plant.

Burns like Gas Flame

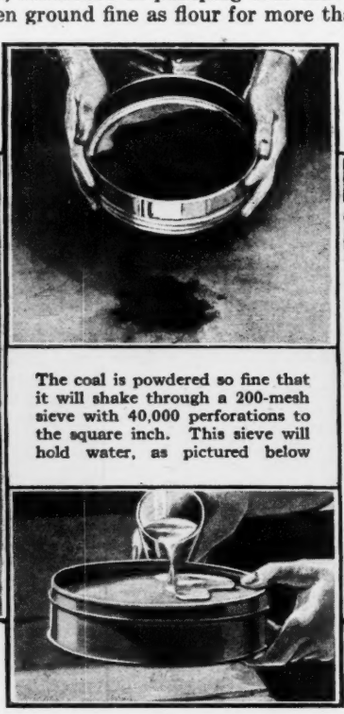
Powdered coal, ground so fine as to pass through a sieve that will hold water, burns as it flows into a furnace, like the ignition of the flow from a household gas jet. Also, as with a gas jet, the quantity issuing may be controlled and any desired heat may be maintained. It produces so much heat, engineers say, that it will greatly increase a boiler's efficiency. This naturally results in greater economy.

Dr. Alexander G. Christie, professor of mechanical engineering at Johns Hopkins University, is authority for the statement that the efficiency of a ton of powdered coal is between 85 and 92 per cent. From 50 to 60 per cent efficiency is considered high for ordinary lump coal as it is burned in some hand-fired boilers, and 76 per cent is high for even the best mechanical stokers.

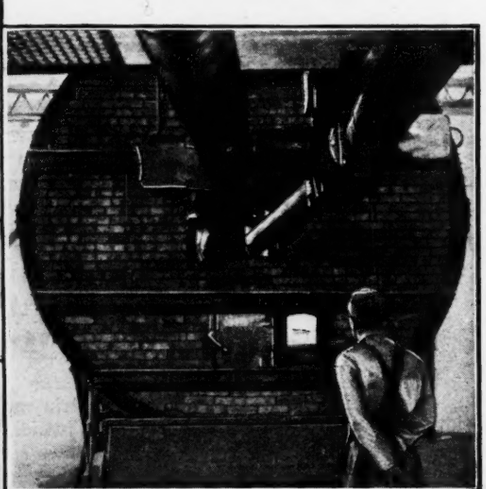
Doctor Christie estimates that it costs about 30 cents a ton to pulverize bituminous coal and 50 cents to pulverize the hard or anthracite coal.



Piping pulverized coal into a cement kiln. From a feed bin the fuel is carried by screw conveyor into an injector, where it is blown by compressed air into the kiln and then fired



The coal is powdered so fine that it will shake through a 200-mesh sieve with 40,000 perforations to the square inch. This sieve will hold water, as pictured below



Shooting with the velocity of a hurricane into the cement kiln, the pulverized coal burns in a great tongue of flame 30 feet long. The injector pipe is seen above the man's head

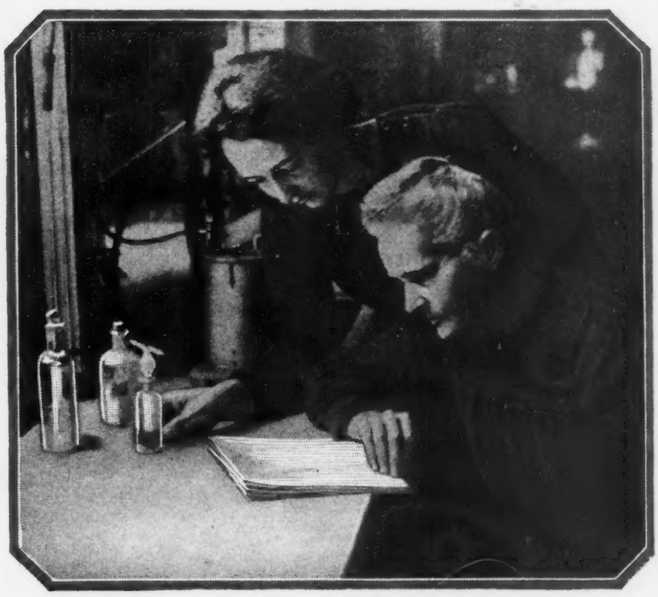
Science Sees, Hears, Counts Atoms

New Triumphs in Spectacular Conquest of Tiny Worlds of Wealth

By Raymond J. Brown

FROM Paris recently came word that Madame Curie, famous as the discoverer of radium, had invented a machine more startling and filled with more dramatic possibilities than even the telescope that gave to man his first real understanding of the sublime wonders of the heavens.

This machine enables scientists to *hear and count atoms.* More than that, it makes it possible to amplify the sounds so that through a radio loudspeaker they may be heard by the audience in a theater or lecture hall. The sounds are ticks produced as helium atoms are discharged from polonium, the daughter element of radium.



The latest portrait of Madame Curie, famous discoverer of radium, seated in her laboratory in Paris, France, where she recently invented a marvelous little machine that enables scientists to hear and count atoms. Standing beside her is her daughter Irene, who is her assistant

Seeing the "Invisible"

A machine more amazing than that, the human mind is incapable of imagining. It may be said to achieve the impossible, for it makes audible and all but tangible the movements of infinitesimal particles of matter that are invisible, and, according to scientists, always must remain invisible to the most powerful microscope that ever can be constructed. For an atom in size is to the smallest thing visible under the microscope as the smallest microscopic body is to our world.

And yet scientists, by other means than microscopes, actually have seen atoms; they have measured them and photographed them, and now they can hear them. Through their studies of atoms they have formulated one of the most startling and important scientific theories of history. They have come to the belief that all creation—the earth on which we live, the air we breathe, the other worlds that whirl through the boundless depths of space, even we ourselves and every conceivable particle of matter that may exist—is electricity; that there is no other substance in the universe.

And in this new theory regarding the composition of the universe, they see possibilities that may revolutionize completely present-day scientific methods, especially in chemistry and physics, and that may point the way toward boons for humanity that all but challenge credence.

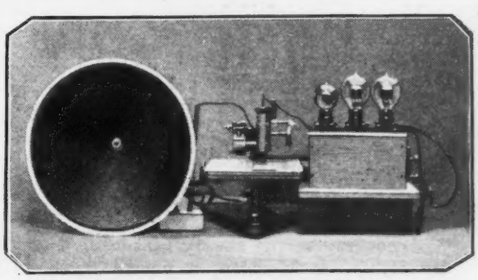
Hidden Sources of Wealth

The transmutation of matter—the change, for example, of lead into gold, or of other materials that are on the earth in plenty into materials that are rarer and more useful; sources of light and heat that will make man independent of the exhaustion of the world's coal and oil; power in such tremendous quantities that all energy previously generated through coal, water, or gasoline will seem puny in comparison—these are only a few of the marvels that have been predicted.

No doubt you have made use more than once of the word "atom" when you wished to convey the idea of anything exceedingly small. You have spoken, for example, of a thing being "blown to atoms." Chemists, though, long ago applied to the word a more restricted meaning. To them an atom was the smallest particle into which a substance could be divided. Possibly it would be better to say the smallest particle of a substance that could be imagined, for the "division" of which the old chemists spoke was entirely theoretical. Nobody hoped to isolate atoms and study their structure.

Now, to all chemists, an atom does not mean the smallest possible particle of *any* substance. There is no such thing, for example, as an atom of water, an atom of wood, or an atom of air. Water, wood, and air are what are known as compound substances. They are—like most of the substances we see around us—formed through combinations of other substances that the chemists call "elements."

Oxygen and hydrogen are elements. So are gold, iron, copper, and other metals. So are helium, the gas now used to inflate airships, and radium, the rarest and most expensive substance known.



This wonderful machine, invented by Madame Curie, makes it possible for an audience to hear helium atoms as they are discharged from polonium, the daughter element of radium. Ticks produced as each successive atom is discharged are made audible with the aid of a loudspeaker. By these sounds the atoms can be counted

What Elements Are

Science says there are 92 elements, 87 of which are known. They are called elements because they have resisted all attempts to decompose them into simpler forms of matter. Oxygen, for example, remains oxygen, no matter what you do to it. You can combine it with some other element, as with hydrogen to form water, but you cannot split it up into any other substance. Its smallest particle remains oxygen.

This property of elements of retaining their individual characteristics is what caused chemists of modern times to laugh at the efforts of the alchemists of old to change one element into another, particularly to form gold from the baser metals. Similarly, as one element after another was discovered, modern chemists laughed at the ancients who thought that all matter was composed of four elements—earth, air, fire, and water.

A Marvelous New Alchemy

But in the light of the wonderful new facts regarding the structure of matter disclosed to us as a result of science's invasion of the realm of atoms, the reason for laughing at the pioneers of science seems not so evident. For the possibility of the transmutation of matter has been demonstrated so conclusively by those who have penetrated the fascinating miniature worlds of atoms that every scientist of standing in the world has accepted it! It was only recently that the American Society for the Advancement of Science, in convention at Cincinnati, went on record as approving the new theory. Moreover, now that science is demonstrating the theory that everything in the universe is essentially electricity, the ancient theory of a four-element world seems not quite so ridiculous.

But how does this new theory work out? If oxygen thus far has resisted successfully all attempts to make anything but oxygen out of it, and iron has remained iron, who dares say that they both are composed of electricity?

Dr. Niels Bohr, who is professor of

mathematical physics at the University of Copenhagen, dares to say so for one. And, because he said so—and proved it to the satisfaction of some of the world's foremost scientists—he was awarded the Nobel Prize for physics and has been hailed as one of the great pathfinders of science.

Sir Ernest Rutherford, president of the British Society for the Advancement of Science, is another who says so—and offers proof of it. Sir J. J. Thomson, noted British scientist, is another. Sir Oliver Lodge, too. The list might be multiplied until it contained the names of every chemist and physicist of renown.

The methods of those who evolved the theory are beyond the comprehension of any but the most learned scientists, but their results are understandable — more, they are filled with thrill and romance; they spur the imagination; they appeal, because they seem headed directly for vast fields of usefulness. This, briefly, is what they say:

The Electrons

The atoms of all substances are composed of a nucleus — a positive charge of electricity—about which from one to 92 electrons — negative charges of electricity — whirl in definite orbits, exactly as the earth and the other planets revolve about the sun.

The electrons travel at a speed that varies—according to their distance from the nucleus—between 2000 and 93,000 miles a second, which means that the number of revolutions an electron will make in a second cannot be recorded in less than 15 figures. In other words, all about us as well as in our own bodies are millions and millions of tiny worlds, each so small that it compares in size with a pinhead as a pinhead compares in size with our world.

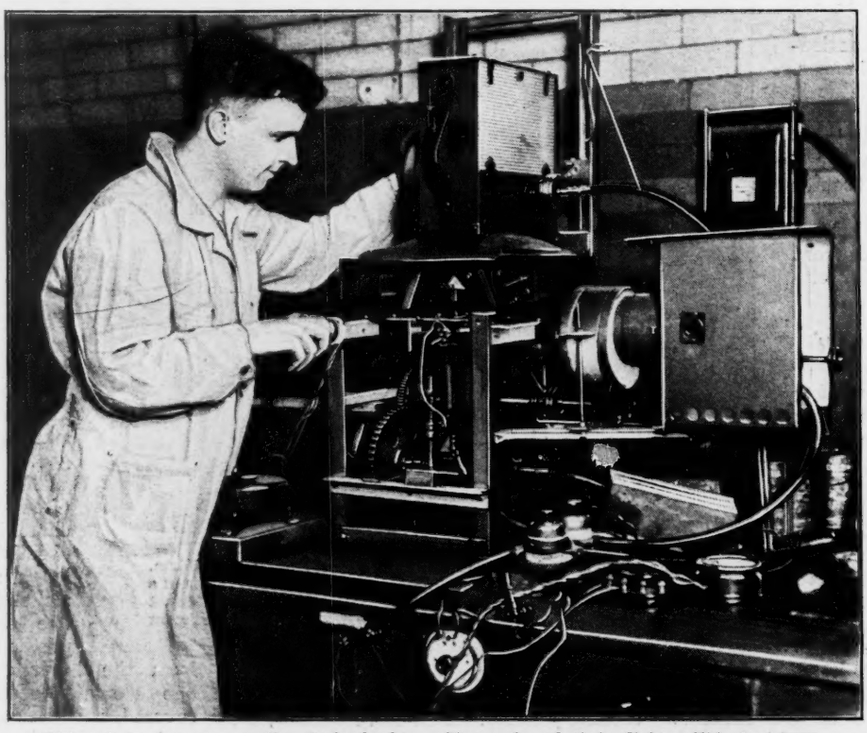
The nuclei are the "suns," the electrons the "planets." The electrons in each atom are relatively as far away from their "sun" as we are from ours, and the mass of the nucleus is about 18,000 times that of each electron. Also, as in our solar system, these incredibly small planets—some moving with half the speed of light—travel truly in their courses, responsive in a measure to the law of gravity, for they attract and repel each other as do the greater bodies in our universe.

And, since the electrons are relatively far from the nuclei, the structure of atoms is open, even empty; so much so that, even in substances like iron, which to us seems like a solid mass, the volume of solid matter in the atoms compared with the whole would be represented by this proportion: 1 to 1,000,000,000,000,000.

The same thing may be expressed in this way: If an atom were a circular field three miles in circumference, the nucleus would be as large as a locomotive's driving wheel and each electron the size of a pea.

Doctor Bohr has said that it would require a million times a million times a million hydrogen atoms to equal in size the smallest speck that could be weighed in a chemical balance. Dr. Paul Foote, of the United States Bureau of Standards, at a time when a trillion German marks were worth 60 cents, asserted that one mark would buy 3,000,000,000 atoms of gold.

A bucketful of water contains so many atoms of hydrogen and oxygen that if each, by some magic alchemy, were transformed into a grain of cement, you'd have sufficient material to construct a motor highway a mile wide and three feet thick, that would circle the United States.



Although atoms are so small as to be far beyond the range of the most powerful microscope, science has succeeded in photographing collisions between them, as well as the comet-like paths of their flight. This has been accomplished at the University of Chicago by the sensitive apparatus shown above, timed to a conventional motion-picture camera

Why Substances Are Different

If you can think in terms like these, you can form in your mind a definite picture of the structure and size of an atom. But how is it, you may ask, if all atoms consist merely of electricity—a positive nucleus surrounded by a whirling group of negative electrons—that we have 92 widely different elements, ranging from light gases like hydrogen and helium to heavy metals like lead and platinum?

According to the theory first advanced by H. G. J. Moseley, a young British scientist killed in the war, and later developed by Doctor Bohr and others, the explanation of that apparent anomaly is quite simple. Substances acquire the properties that make them differ from one another—their weight, their color, whether they are solid, gaseous, or liquid and so on—according to the number of electrons that revolve about their positive nuclei.

Thus, if you take for a nucleus a single positive charge—or proton, as it is sometimes called—and set a single electron spinning about it, you have an atom of hydrogen, for hydrogen has an atomic solar system consisting of only one "sun" and one "planet." If you can manage to persuade 31 additional electrons to enter this miniature solar system, and introduce a positive charge of equal value into your nucleus, your atom of hydrogen—which, by the way, is the lightest known substance — becomes an atom of copper.

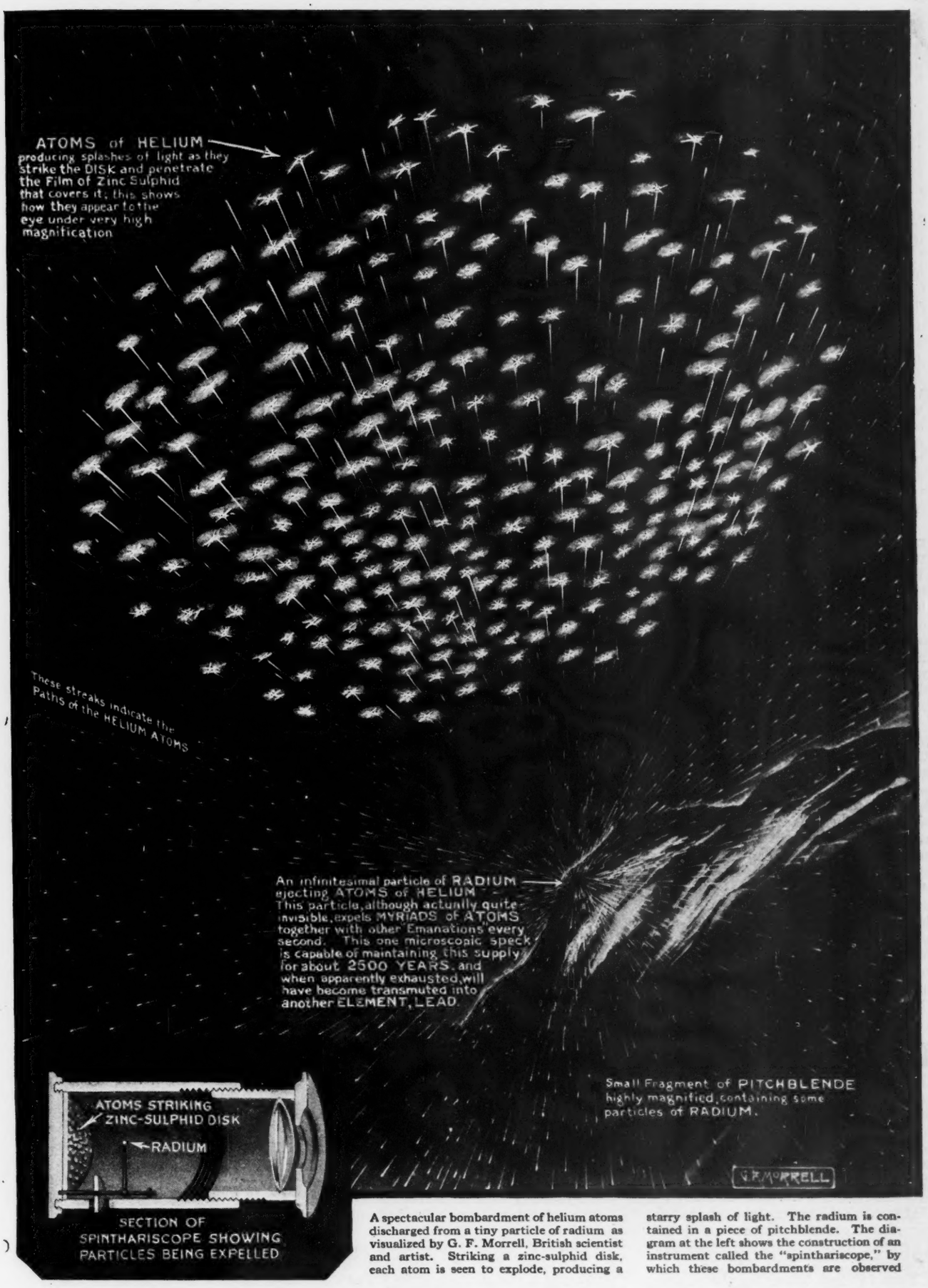
If you could draw out 26 of the electrons that you let into your solar system and leave enough positive electricity in the nucleus to neutralize the remainder, your atom of copper would become straightway an atom of carbon.

Changing Atoms

It might occur to you here that you'd like to have an atom of uranium, which is the heaviest known substance. To do this, all that is necessary is to add 86 electrons to the six that are whirling about in your carbon atom and increase your positive charge correspondingly.

There is an even more dramatic transformation that is theoretically possible and that should be even easier than any of those suggested. An atom of mercury consists of a nucleus with 80 electrons as satellites. If in some way you could dislodge only one of those electrons and maintain the proper balance in the nucleus, you would have an atom of gold, for gold is the substance next to mercury in the atomic scale, its atoms consisting of a nucleus and 79 electrons.

Attempts to effect this transformation, or transmutation, for it would be exactly that, actually have been attempted by scientists of the United States Bureau of Standards in Washington. They have hurled heavy charges of electricity into tubes containing vaporized mercury, the idea being that the onrush of free electrons—for this is what modern science believes the flow of electric current to be—might dislodge the necessary electrons and protons from the atoms of mercury and thereby change the mercury into gold. The world's supply of gold has not yet been increased by this method, but the actual accomplishment, scientists assert, awaits only the development of apparatus capable of maintaining a 1,000,000-volt current.


ATOMS of HELIUM
producing splashes of light as they strike the DISK and penetrate the Film of Zinc Sulphid that covers it; this shows how they appear to the eye under very high magnification
These streaks indicate the Paths of the HELIUM ATOMS
An infinitesimal particle of RADIUM ejecting ATOMS of HELIUM. This particle, although actually quite invisible, expels MYRIADS of ATOMS together with other Emanations every second. This one microscopic speck is capable of maintaining this supply for about 2500 YEARS, and when apparently exhausted, will have become transmuted into another ELEMENT, LEAD.
Small Fragment of PITCHBLENDE highly magnified, containing some particles of RADIUM.
G.F. MORRELL
ATOMS STRIKING ZINC-SULPHID DISK
RADIUM
SECTION OF SPINTHARISCOPE SHOWING PARTICLES BEING EXPELLED

A spectacular bombardment of helium atoms discharged from a tiny particle of radium as visualized by G. F. Morrell, British scientist and artist. Striking a zinc-sulphid disk, each atom is seen to explode, producing a starry splash of light. The radium is contained in a piece of pitchblende. The diagram at the left shows the construction of an instrument called the "spinthariscope," by which these bombardments are observed

Even before science knew as much as it now knows about the composition of atoms, the little planets that whirl about in the atomic worlds were being put to work for the benefit of mankind. What was the attempt to turn mercury into gold by electronic bombardment but the thing that has been done for years in the mercury vapor lamps found in every commercial photographer's establishment, in every moving picture studio, in thousands of shops and factories?

The vacuum tubes that are the detectors and amplifiers of your radio set, the

(*Continued on page 133*)

In the Mirror of Science

New Discoveries and What They Promise for You

The Conquest of Disease

WILL man ever be in complete control of the diseases to which he is now subject? Will the time ever come when the only causes of death will be old age and violence?

Announcement of amazing advances in medical science have been made during the last few weeks. Dr. A. R. Dochez, of Columbia, reports the discovery of a serum for scarlet fever, a disease of childhood that has puzzled physicians for more than half a century, while from Chicago comes word that Drs. George F. Dick and Gladys Henry Dick have devised a test to determine human susceptibility to this disease. The test is expected to do for scarlet fever what the Schick test does for diphtheria.

A preventive serum for measles is another discovery, made by Drs. George H. Weaver and T. T. Crooks at the John McCormick Institute for Infectious Diseases at Chicago. And Doctor Manueline, of the Pasteur Institute, Paris, has isolated the microbe of rabies, which even Pasteur, discoverer of the anti-rabies serum, sought vainly to do.

Cancer, too, eventually must yield to the advance of science. On the next page is pictured a giant X-ray tube developed by an American scientist, which has put a new and powerful weapon into the hands of physicians who are fighting this terrible disease. Meanwhile two Parisian physicians, Drs. A. Kotzareff and L. Weyl, by adding radio emanations to a blood serum, have been able to obtain photographs of cancers inside the body, a method hailed as giving promise of far-reaching effects in the detection and treatment of the disease.

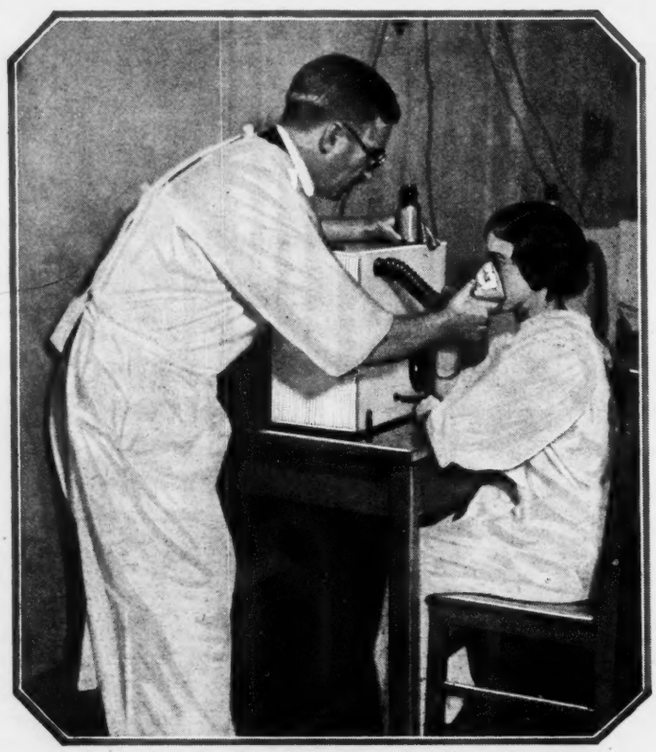
* * *

A New Universe Discovered

LIGHT travels at the rate of 186,000 miles a second. How far away from the earth, then, is an object whose light takes a million years to reach here? The distance is six billion billion miles—six followed by eighteen ciphers—according to astronomers of the Harvard Observatory who recently photographed a new universe that far away from us. So far as is known this is the most distant object that man ever has seen, although that does not mean there are not other worlds fifty, a hundred or even a million times as far away.

Even to large telescopes the new universe is merely a faint luminous blur, but the pictures made of it by the 100-inch reflecting telescope at Mount Wilson, Calif., the largest in the world, made possible the identification of this hazy pinpoint of light as a universe like ours, although apparently much smaller. Astronomers know our newly identified neighbor of the sky only as "N. G. C. 6822."

Perhaps the inhabitants of other worlds in the depths of space call our solar system by some equally casual title and wonder if its planets are inhabited.



In a new treatment for pulmonary tuberculosis announced by Dr. Thomas F. Nolan, of New York City, the patient inhales uncrystallized carbon and calcium salts, which are said to build up the fibrous tissues of the lungs, arresting the progress of the disease. Doctor Nolan is shown above demonstrating the use of his inhaler

A Successor to Moth Balls

WOOLEN clothing and furs now may be protected absolutely against moths, it is said, by impregnating them with a new chemical called "Eulan F," developed in Germany after more than a half century of experiment. The substance is non-poisonous to human beings and harmless to the garments, but is said to cause instant death to the larvæ of moths.

Almost 60 years ago German dyers noted that goods dyed green was safe from moths, and it was found that this was due to a certain pigment used in green dye. Since then chemists had sought a moth-proofing substance that could be used on clothing of any color, but only recently were they successful.

"Eulan F" is used in wool or furs in manufacture; then it is sprayed on at infrequent intervals during the life of the garments. Some time this process will come into general use. Then you can put your furs away for the summer without the conventional camphor balls and feel no uneasiness about its safety.

Locating Ore by Quakes

SCIENTISTS in Switzerland recently devised an ingenious, and, it is said, virtually infallible method of prospecting for ore. They use imitation earthquakes; that is, ground tremors produced by violent explosions.

Observers of earthquakes have known that the wave forms traced by seismographs during a quake give definite information regarding the rock formations in the area of the disturbance. Hence, reasoned the Swiss scientists, if a violent explosion is produced in the center of a section where ore has been found, seismographs placed at various points will record graphically how far and in what directions the ore-bearing rock extends, thus making unnecessary experimental sinking of shafts and other cumbersome methods of prospecting.

* * *

Mice and Men

PROFESSOR Ivan P. Pawlow, Russian physiologist, has taught white mice to answer the dinner bell. In doing so, he found that although the first generation required 300 lessons to learn that the bell meant feeding time, the second generation needed only 30 lessons, and the fifth generation only five. In time, the professor says, he expects newborn mice to know what the ringing of a bell means without instruction.

These experiments have convinced him that acquired abilities are a matter of physiology and not of psychology, and that they may be inherited. If his theory stands the test of more exhaustive experiment, it will mean that you can assure your son of success by passing along to him an aptitude for acquiring your hard-won abilities.

* * *

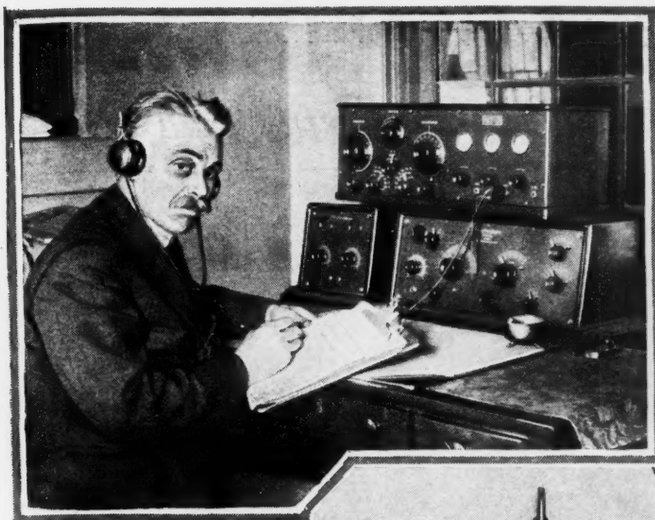
A Boy or a Girl—Which?

WHETHER it is to be a boy or a girl has ever been a profound mystery. Now, though, Dr. Isaac Fried, of Czecho-Slovakia, declares that by a blood test he can ascertain the sex of a child four months before birth, a discovery bound to lead to important advances in eugenics.

* * *

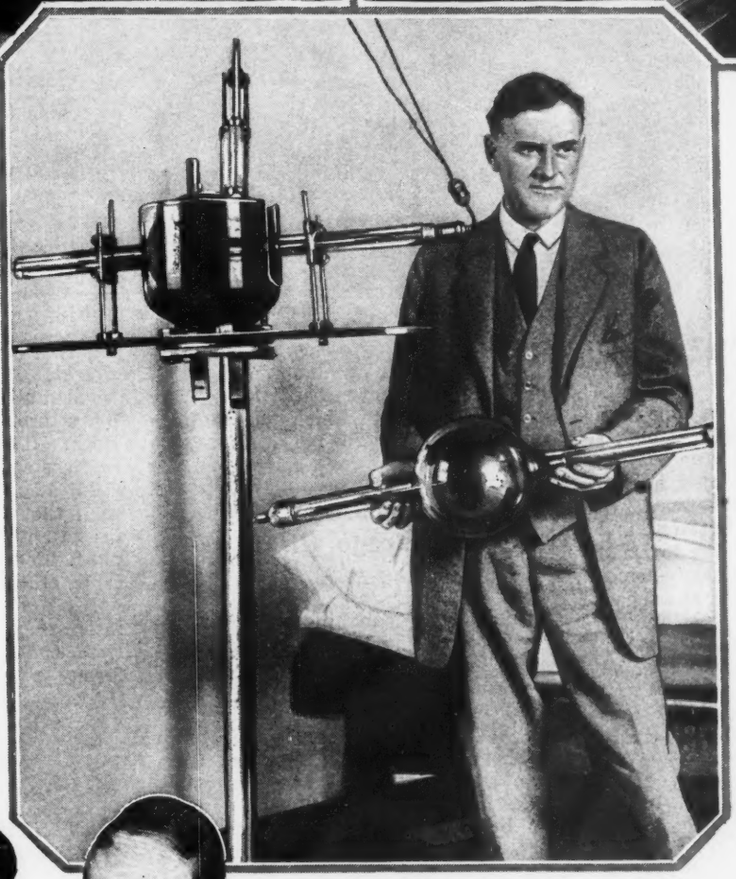
More Triumphs for Radio

RADIO waves apparently recognize no barriers. A broadcast concert has been heard in a tunnel under the Hudson River. Wireless code signals have been picked up 1400 feet underground in an Arizona mine. The present generation may yet see radio superseding the telephone, telegraph, and cable.



© Foto Topics, Inc.

The first American to catch the "Hello, America" broadcast from England a few weeks ago was Hiram Percy Maxim, president of the American Radio Relay League. He is shown above with his double receiving radio apparatus

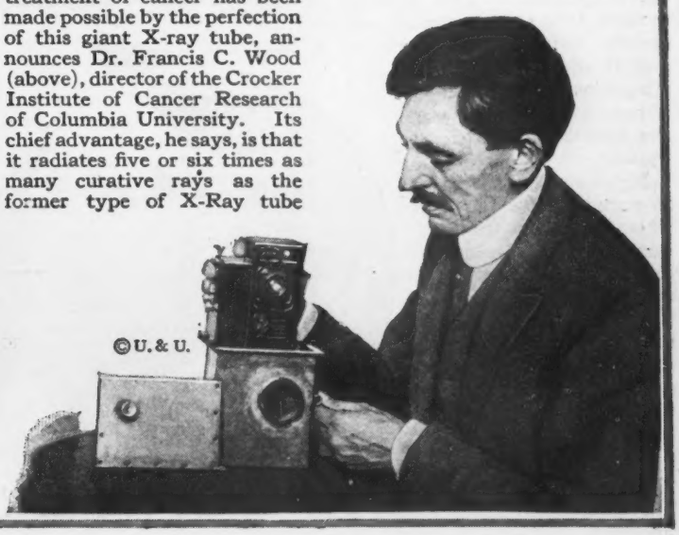


An unusual instrument that measures velocity of the wind by sound has been invented by Abbé Rousselot, a venerable teacher of science in the College of France. As the wind drives the machine at various speeds, it produces sounds of varying pitch. Measurement of the sound vibrations determines the wind velocity

That metals, like men, "get tired" and break down, often causing accidents, has been revealed in investigations by the Physics Department of the University of Illinois. Below Prof. H. F. Moore and Prof. T. M. Jasper of the department are seen inspecting a piece of metal that resisted more than a billion stresses before it broke down

A distinct advance in the X-ray treatment of cancer has been made possible by the perfection of this giant X-ray tube, announces Dr. Francis C. Wood (above), director of the Crocker Institute of Cancer Research of Columbia University. Its chief advantage, he says, is that it radiates five or six times as many curative rays as the former type of X-Ray tube

Photographing wonders of the deep sea has been simplified by Dr. Paul Bartsch (below) of the Division of Mollusks, National Museum, Washington, D. C., who has invented a pocket-size movie camera that can be operated efficiently under water. The camera is inserted in a watertight copper box fitted with a lens and finder



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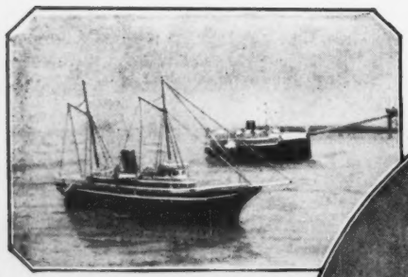
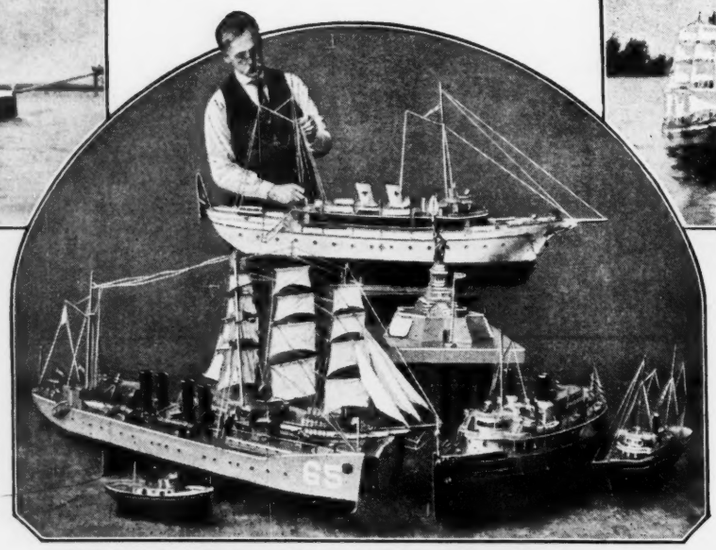
"Why I Value My Hobby"

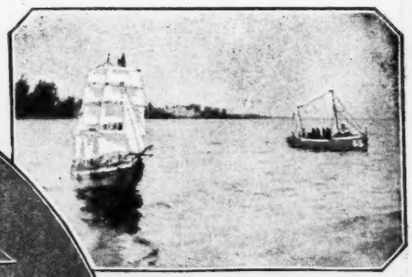
Prize Contest Winners Find Happiness in Useful Relaxation



Model yacht and steamship, sailing on Saginaw Bay



F. G. Griffin of Saginaw, Mich., with his sheet-metal ship models



Model sailing ship and destroyer, built as a hobby

POPULAR SCIENCE MONTHLY'S Hobby Contest brought excellent photographs and letters from our readers telling how they found health, happiness, and success in diverting occupations. From these the judges have selected the following:

By F. G. Griffin, Saginaw, Mich.

First prize, $20

A FEW years ago, if some one had asked me whether I had a hobby, I should have been at a loss for an answer. I did not start out to develop a hobby. It just came about in a natural way.

I am in the sheet-metal business, and often had thought I should like to make something out of the ordinary—something that would tax my ability as a sheet-metal worker to the limit. Anything in the form of a model always has drawn my attention; so I decided to make a model ship.

My first work was a model of the Red Cross ship *Irene*, 54 inches long and made entirely of sheet metal. I became so interested in this work that I could not stop, and so I made several other ship models.

The work calls for a great deal of pattern drafting, designing, careful study of proportion, as well as resourcefulness in finding materials with which to fit out the different boats. The painting of the models, too, calls for much research. I greatly enjoyed the work, of course, and it did not strain my patience, as several of my friends who saw the models thought it would.

My shop has become a paradise for boys whom I always entertain. It is a pleasure to me to hear their comments. They watch me intently as I perform all the details that go to complete the models, and it gives them ideas for making boats of their own. A number of the boys have created several very good models.

Making these ships has helped me in my work for other people in many ways, so I feel that I have a real hobby, one that fills in the time which might otherwise be wasted. To me it is a real recreation.

By Irving J. Newman Chicago, Ill.

Second Prize, $10

MY HOBBY is making and entertaining with Punch and Judy shows. I am still a senior in high school, so I am far from being a professional.

Ever since I was a very small boy, I have been interested in puppet and marionette shows, those operated from above by wires, and those, like mine, worked from below by the hands. I have been building new shows, taking them apart, or improving them, buying new dolls, and writing new plays, ever since I can easily remember. I have given my shows for many of my friends, at charity bazaars, children's parties, private schools, and, among other places, the toy department of Chicago's largest department store.

My chief difficulty was in building a show that would be six feet high and two feet square, one that would stand up substantially, and yet would fold into an ordinary suitcase. I have accomplished this in making one that is strong enough to support my weight. It is built of two by two inch wooden uprights and crosspieces, covered by a brown and white boxed awning cloth. The whole outfit folds into a suitcase and weighs about 40 pounds.

My 12 dolls were imported from France, and they have elaborate heads and dresses. The performance is the regular old-fashioned combination tragedy and farce, abridged to meet my requirements.

My hobby has furnished me with an interesting, instructive, and useful pastime, and has given me a profitable use for my spare time.

By Olivia M. Kirby Nyack, New York

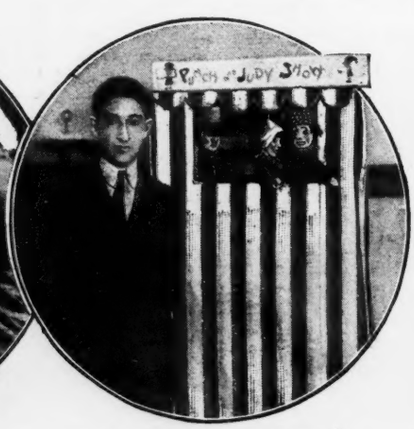
Third Prize, $5

MY HOBBY is sawing wood! Not figuratively, but literally. And the reason I value my hobby is because it brings me that matchless thing—health, which, of course, means happiness and the joy of life coursing through me.

It carries a certain mental satisfaction, too. I feel that I am accomplishing something as I pile up the sawed-off lengths of wood and realize that I shall have plenty of fodder for my two cozy open fireplaces.

There's a lot of exercise besides just sawing the wood. There's the handling of it, the stacking it up and carrying it into the house. Out of it all I get exercise for every muscle in my body and to me it's play, jolly good fun, and I love it.

Olivia M. Kirby limbering her muscles at her favorite hobby—sawing wood



Irving J. Newman, Chicago high school senior, standing beside his puppet show

Nature's Own Alarm System

Every Headache a Warning from Your Bodily Machinery

By Edwin F. Bowers, M.D.

YOU are the operator of one of the most elaborate and most important machines in the world. Its working depends on many small parts, any one of which, if out of order, will impair the efficiency of the whole.

That machine is your body. It must see you through life.

Sometimes this machine of yours gets out of order because you abuse it, and sometimes for other reasons. But, unlike the ordinary machine, it never breaks down without warning. These warnings are called headaches. If you do not heed them, the machine's efficiency will be lessened, and the fault is yours.

In other words, a headache is not a disease, but a symptom. It is not an affliction, painful though it may be, but a valuable and useful alarm conveyed by the wonderful signaling system of the body.

Aches of Sympathy

In a broad sense, sympathy alone prompts most headaches. If the liver, the stomach, the ears, the eyes, or, in fact, any of the organs that are the cogs in your bodily machine, get out of mesh or alinement, the automatic signaling system connecting them with your head quickly tells the head about it. The head is commanded to ache, and the head promptly and more or less cheerfully acquiesces.

Perhaps the most common form of headache is that caused by wire trouble in your body signaling system—nerve irritation. Loss of sleep, grief, business worries, undue excitement—anything, in fact, that hurts or annoys the nervous system—can and does make the head ache.

Find the Causes

How to avoid or remove the *causes* of these aches is your business, for you are operator of the machine. The headache isn't concerned with this. Its job is done when it flashes the pain signal from your harried nerves. It is your job to discover that you need more sleep and less excitement; that you must avoid worry.

And yet many people who have recurrent headaches and are well aware of the cause do nothing to stop them—pay no attention to the frantic signaling of their alarm systems. I knew a man, typical of many husbands, who was much put out whenever he arrived home and found his dinner late. His irritation inevitably led to stormy words with his wife, who, in turn, was irritated because her household routine had been interrupted, and was more than willing to air her wrongs.

The result was that the nervous systems of both were upset and they went to bed with sick headaches. This happened time after time; still they paid no attention to the protests of their bodies. Similar tactics on the part of a machine operator would cause his discharge in any industrial plant.

Next to nerve irritation, the most common form of headache comes from the fouling of your bodily machine by foreign matter—a process of poisoning arising from the absorption into the circulation of poisons generated in the intestines. These are among the most dangerous poisons known — twin brothers to the deadly curari with which the Orinoco Indians of South America tip their murderous arrows.

If isolated and injected directly into the blood, these "putrefactive alkaloids," as they are called, would kill like cobra venom. Fortunately, in passing into the blood, their virulence is partly neutralized and overcome. But they are poisonous enough. Their presence in your bodily machine should tell you as operator that the machine is clogged through constipation and requires cleaning. A mild course of cathartics perhaps is the most useful way of ridding the body of these poisonous waste products.

Nervous strain

Close reading

Overeating

Flickering movies

A headache, says Doctor Bowers, is not a disease, but a valuable alarm, warning of a fault somewhere in the bodily machinery. Common causes of these painful danger signals are shown in the illustrations and listed below

The Poison of Fatigue

The bodily machine may also be fouled by being overworked. Overwork causes fatigue poisons to accumulate in the blood faster than the red cells can burn them up. The result is the kind of headache to which those who do confining indoor work are particularly subject—a dull throb that comes from muscle weariness.

The head is imperatively demanding that the bodily machine be given a period of rest—a chance to cool down and thereby destroy the poisonous debris that has been accumulating. In other words, the time has come for you to shut off the power from your machine. If you are a competent operator, you will do it.

Fresh Air Needed

A well-known actor came to me not long ago seeking relief from recurring headaches. He had diagnosed his trouble as due to the nervous strain of perform-

Ten Reasons Why Your Head Aches

1. ***Nerve irritation.*** You need more sleep, less worry, or less excitement.
2. ***Poison.*** Your body machine is clogged with waste. It needs cleaning out.
3. ***Overwork.*** You need to shut off power and let the body machine cool down.
4. ***Stuffy rooms.*** Your body needs a fresh-air bath.
5. ***Biliousness,*** "sour stomach." Eat less fried foods, pastries, starch, sugar.
6. ***Overeating.*** You're feeding your body more fuel than it can consume.
7. ***Eyestrain.*** Avoid glaring lights and prolonged close work.
8. ***Eye defects.*** You need the services of a mechanic—an eye specialist.
9. ***Overstimulation.*** Drink less coffee and cut down on your smoking.
10. ***Decayed teeth.*** You need to visit your dentist more regularly for repairs.

ing a particularly exacting rôle during a long run. That might have caused his headaches, but as a matter of fact it had not—not entirely. His bodily machine had become clogged because he had been inhaling impure air night after night.

It happened that the theater in which he had been performing was poorly ventilated. The result was that he had not been taking in sufficient oxygen to overcome the poisons that his bodily machine generated as it worked. On the contrary, he had been aggravating the condition by breathing carbon-dioxid poisons emanating from the several hundred other human beings who made up his nightly audiences.

His sort of headache may be described as the "stuffy room" headache. It is a sign that the bodily machine needs a fresh-air cleaning.

Time for Repairs

Biliousness is another cause of headache—headache absolutely mulish in its obstinacy. This form of headache is an indication that the bodily mechanism is out of adjustment and requires overhauling. Dieting, copious flushing of the digestive units of the machine with lemon water, or some mild alkaline liver stimulant, usually gets the machine to working right again and causes the headache which gave warning to disappear.

Somewhat similarly "sour stomach" will produce headache—once again an indication that the bodily machinery is clogged. Abstinence from fried foods, pastries, and excess of starches and sugars, as well as an occasional dose of milk of magnesia or some other efficient alkali will correct this condition.

Too much fuel in your bodily furnace—in other words, overeating, causes the alarm system to flash a headache warning. This is due to the poisonous material generated by the fermentation of too much food, or too much of the wrong kind of food. Elimination of the poison by catharsis and a lessening of the fuel supply usually will end the headaches.

Eyestrain a Cause of Headaches

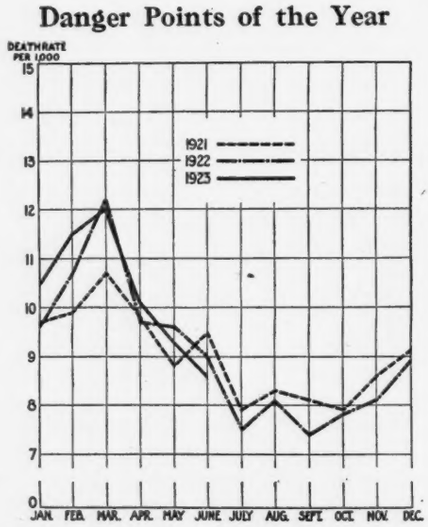
Eyestrain probably is the next most frequent cause of headache. This is another form of overwork to which your bodily machine objects. Exposing the eyes to the glare of sand, sea, or unshaded incandescent lights; prolonged focusing on a flickering moving-picture screen; intently watching a brightly lighted stage from an unnatural angle; sewing, reading, writing, and other forms of close application continued for hours on end—any one of these will bring a violent and enduring headache.

Or the muscles of your eyes may be out of balance—a defect in the construction of your machine. In this case to relieve your headache you will require the services of an expert mechanic—an eye specialist. Your machine needs mechanical repairs, which means an operation; or new parts, which means eyeglasses. Since medical science computes that fully one third of the total functional activity of the brain is expended in receiving and conveying eye impressions, it is not surprising that an extra strain upon the eye muscles produces an unfavorable reaction.

If you suffer from chronic headache and cannot trace it to its cause by inspecting your bodily machine according to the suggestions I have given here, it would be well to call in a doctor and let him make a urinalysis and a blood pressure test to determine whether your kidneys are acting normally. If you lead a sedentary life and eat much meat, you should do this at least once a year. Many hundreds of lives would be saved annually by thus determining the presence of hardening of the arteries and kidney disease in their early and curable stages.

The most scientifically equipped fire-alarm telegraph station in the world, recently established in the Borough of the Bronx, New York, is no more sensitive or efficient than the headache alarm system with which Nature has endowed the human body. Yet there is this vast difference between the two: The fire alarm brings prompt and ready response, while the warnings of danger flashed from our bodies too often go unheeded by us until the damage has been done

Danger Points of the Year



This chart of the Metropolitan Life Insurance Company, based on the death-rate records in the United States for the last three years, clearly shows the high danger points of the year—February and March. The peak is reached the first of March. This is the time of year when headache warnings should be heeded most closely

It may be that your headache comes from your habit of "doping" your bodily fuel, as automobile men say. Too much coffee drinking is likely to produce headache, for coffee contains an alkaloid called caffeine, which is an active stimulant. Up to a certain point coffee may be a most useful and beneficial stimulant or tonic, but too much may be harmful, especially if taken at night in sufficient quantities to produce insomnia, or disturbing restless dreams. Abuse of tobacco also may cause overstimulation that manifests itself in the form of headache.

A False Argument

A business man whom I had for a patient recently, objected when I attributed his headaches to his habit of drinking eight or 10 cups of coffee every day and consuming heavy cigars in constant succession.

"But, doctor," he said, "I've been doing that for 20 years!"

That is an argument frequently advanced to physicians who advise patients to change their accustomed mode of living for the sake of their health. It is illogical, of course. If nature has been kind enough to permit you to pursue an unhygienic, if pleasant, course of life without causing you pain, it gives you no license to affront nature by continuing your unwholesome habits after nature has sounded a warning.

Decayed teeth are not infrequent causes of neuralgic headaches, as they are of many more serious illnesses. In this era of competent dentistry and free dental clinics there is no logical excuse for such poisoning.

Catarrh and long-continued irritation of the nose cavities from a twist in the partition that separates them; enlarged bones, or thickened mucus membranes are prolific sources of headaches. If the cause is merely congestion of the nasal membranes, strong pressure on the center of the tongue morning and evening with a tongue depressor often will give relief to the sufferer.

So it is apparent that headache invariably means something besides a headache. If you will take the trouble to find out what this something is and remove it, you will be convinced of what I said before—that headache is the most useful pain you can have. However else headache may be treated, it never should be treated with contempt.

HOW would you like to add 20 years to your life? Medical science says it can be done, and has provided the means by which you can do it. An unusually interesting article on the subject by James E. Tobey, executive secretary of the National Health Council, will appear in the May issue.

In Armor of Nails, Hunter Will Battle Wolves

ENVELOPED from head to feet in a suit of armor spiked with a thousand nail points, Stanley Carlson, of St. Paul, Minn., is venturing into the wilds of northern Ontario to meet and conquer hungry wolf packs in hand-to-hand combat.

The armor is the invention of this knight of the open places. It consists of a cowhide suit through which more than 1000 nails have been driven with their points projecting outward; helmet and gloves with similar spikes, and a wire mask, resembling that of a fencer. The armor weighs only 27 pounds.

The suit is fastened in front with strong metal clasps. In his right hand the hunter carries his trusty double-bladed ax, while a dagger-like hunting knife reposes in one of the clasps at his waist.

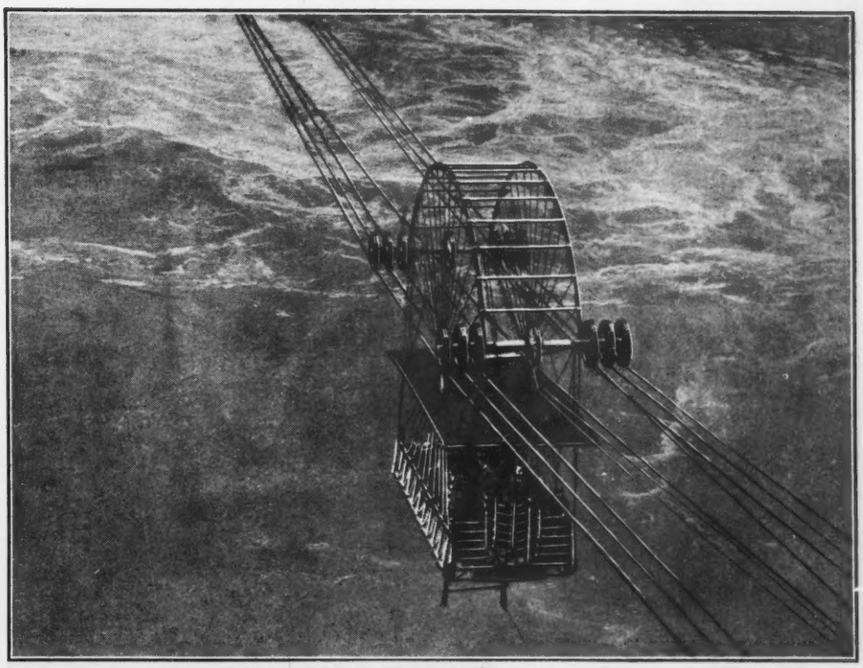
The wolf hunter in his nail armor

Standing unharmed in the midst of a hungry wolf pack, Carlson expects to strike them down with his ax and finish them with his knife. He believes that the high government bounty on wolves will make his invention profitable.

A Strange Shouting Fish

A NEW species of fish that is brilliantly illuminated and that makes a loud shouting noise when chasing smaller fishes has been discovered in the waters of Monterey Bay, Calif., according to Dr. C. W. Greene, of the University of Missouri. Its ability to shout is due to the peculiar construction of its swim bladder, he says. The noise is produced by gaseous contents of the bladder.

The fish is said to carry 350 phosphorescent lights.



Across Niagara's Whirlpools in a Cable Car

ONE of the most exciting of the world's perfectly safe trips is a ride in the cable car that carries Niagara visitors across the river above where the foaming waters swirl viciously in the famous Whirlpool Rapids. The car, slung from a wheeled carriage that rides along a series of cables, glides smoothly nearly 200 feet above the boiling current, affording an exhilarating thrill.

Horses Give Their Blood for War on Diphtheria

BLOOD in small quantities from two horses, Charlie and Jim, owned by the United States Public Health Service, is used to set the standard required for all diphtheria antitoxin made in the United States.

Healthy and powerful, they have blood that thoroughly tests the efficacy of the antitoxins. For six years they have done this service toward saving the lives of thousands of babies. They are content, apparently being satisfied that they have a snug and easy berth.

Every four months government health officers call upon them for blood.

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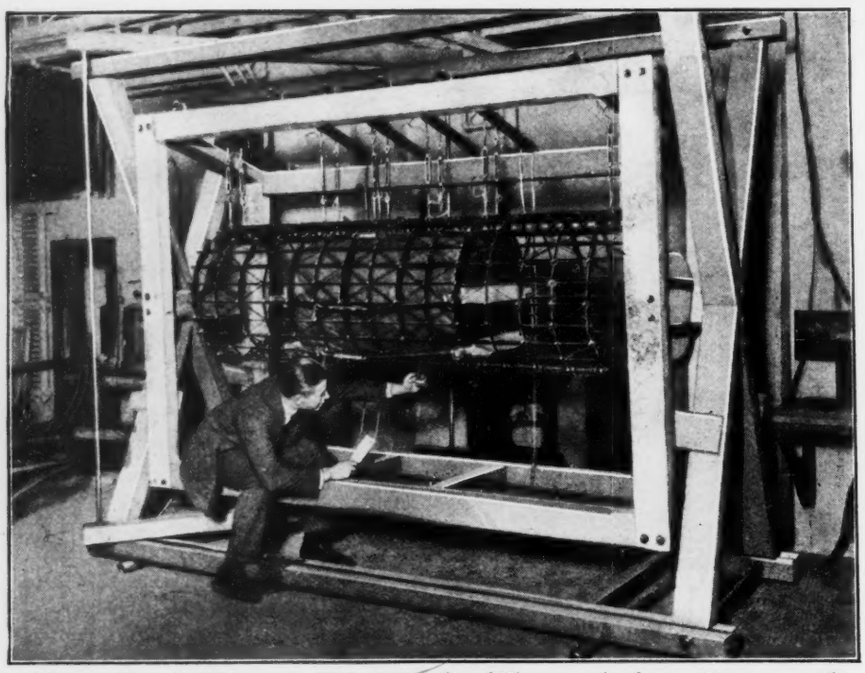
Charlie and Jim, Public Health horses

Will You Be Able to Do This when You Are 70?

AT THE age of 70, Tom Onzo, nationally famous walker and specialty acrobat, still can scratch the top of his head with the toe of his shoe.

He attributes his agility to the habit of regular and strenuous exercise. In the last 40 years he has walked many thousands of miles, traversing every state in the Union.

He formerly was with Ringling Brothers' circus and also was a vaudeville performer.



Model of Great Dirigible Tested for Strength

PLAYING polarized light through a celluloid model of the navy dirigible *Shenandoah*, formerly the ZR-1, scientists in the laboratories of the Massachusetts Institute of Technology have been reading for 10 months the structural secrets revealed by the rainbow lights that appear at stress points.

The phenomenon of photoelasticity, the latest of safety tests, thus is recruited to prepare the great airship for her proposed flight to the North Pole next summer, and to prevent a repetition of the disasters that overtook the ZR-2, the *Roma*, and more recently, the French ship *Dixmude*.

The model consists of several thousand celluloid pieces, machined precisely to scale and fitted into an accurate miniature of the great airship. Since celluloid acts structurally as do metals, all stresses in the actual dirigible are revealed by the play of polarized light upon this model.

Safety-Razor Blades Honed and Stropped Quickly

A SHAVE every day for six months —182 shaves in all — with the same safety-razor blade, is the feat said to be possible with this new honing and stropping machine.

Stropping a blade

For honing, the blade is set in a carriage that, moved back and forth, presents alternate edges to an emery block. At the end of each second movement, an ingenious arrangement reverses the blade, so that the process is repeated on the other side.

For stropping, the blade is inserted on the opposite side of the machine, which has a stropping block.

A Midget Car for Two

IT MAY not look like one, but it's an automobile, even to the self-starter and the spare tire. In fact, its German makers claim it has virtually every mechanical feature found on large cars. The upholstered seat carries two.

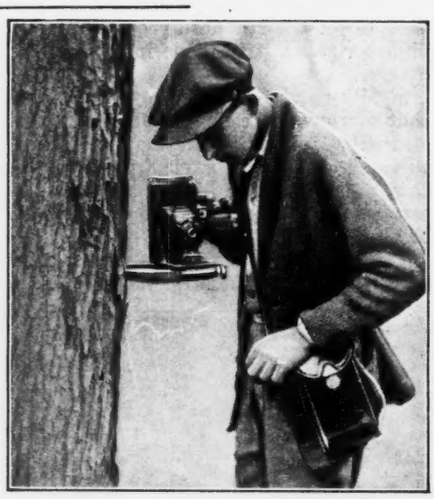
Portable Acetylene Lamp Designed for Safety

A PORTABLE light for night work, said to be safe and powerful, is provided in a novel acetylene generator. Even if knocked over, no sudden flood of gas will result, it is claimed.

Unlike the action of most carbide generators, small quantities of carbide are dropped into an ample container of water. Usually it is the water that is dropped on the carbide.

The lamp is said to furnish 5000 candlepower. Since the weight of the light is mostly at the bottom, it is said to stand safely on a 30-degree slope, without interfering with generation.

The powerful lamp is carried easily



Camera Support Made from Two Hunting Knives

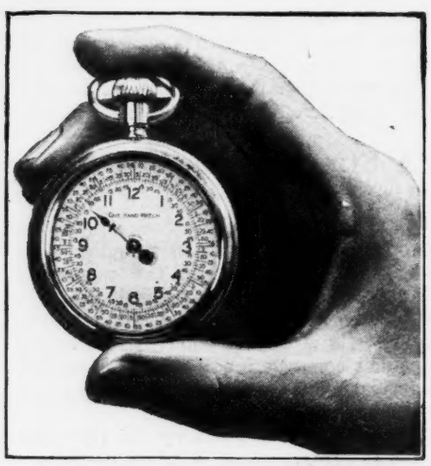
INGENUITY and a pair of hunting knives substituted successfully for a camera tripod when W. L. Thompson, of Dublin, Tex., tried for an especially good time-exposure photograph on a recent hunting trip.

The points of the knives he stuck into a tree trunk in such a way that the handles formed a level and firm support for the camera.

The "knife tripod" thus was prepared for action more readily than would have been possible with an ordinary folding tripod and eliminated an extra load.

One-Hand, 40-Hour Watch

THIS one-hand watch is said to run 40 hours, simply because it does not have to drive a minute hand around the dial 24 times a day. The watch face is marked off in hours divided into five-minute intervals, each of which is numbered.



One-hand watch, showing dial divisions

Straw Gas for Light, Heat, and Power on the Farm

STRAW soon may be lighting the farmer's house, cooking his meals, substituting for coal in winter and even running his automobile. The United States Bureau of Chemistry has discovered a practicable method by which a ton of sun-dried wheat straw is said to yield 10,000 cubic feet of illuminating gas, 10 gallons of tar, and 625 pounds of carbon residue, which is an excellent fuel. The gas is said to burn successfully in a mantle lamp, producing a blue flame restful to the eyes. Experts of the bureau also claim that it can be used efficiently to operate a stationary internal combustion engine.

They estimate that 300,000 cubic feet of straw gas would do the cooking, house lighting, and heating on the average farm for a year. Of this amount, 55,000 cubic feet would be used for cooking, 19,000 for lighting, 201,000 for heating the house, and 25,000 for heating water. About 235 cubic feet would be used daily during the summer and about 1750 in winter.

From 45 to 50 tons of dry straw would be needed to produce this quantity of gas, assuming that straw would be used as fuel in distilling the gas. If wood were used, less straw would be required. Half a ton of straw burned in the firebox will carbonize one ton of straw in the retort. Experts of the Bureau of Chemistry have designed a special retort for the process in order to obtain heat and the by-products mentioned.

Retort for making straw gas on the farm, devised by the Bureau of Chemistry

The gas bubbles up through water and then through fine-meshed screens and a layer of coke and charcoal. Thus purified, it passes to a storage chamber.

According to the bureau, straw gas holds possibilities as automobile fuel. Cars have been operated by it experimentally, the gas being carried in a rubber bag. One car carrying 300 cubic feet of the gas ran 15 miles with no other fuel.

Shoes Shined for a Penny by Slot Machine

DUST and mud are cleaned off the shoes of pedestrians in a jiffy by an ingenious penny-in-the-slot brushing machine that recently made its appearance along the sidewalks and in public places of some of the large cities throughout the country.

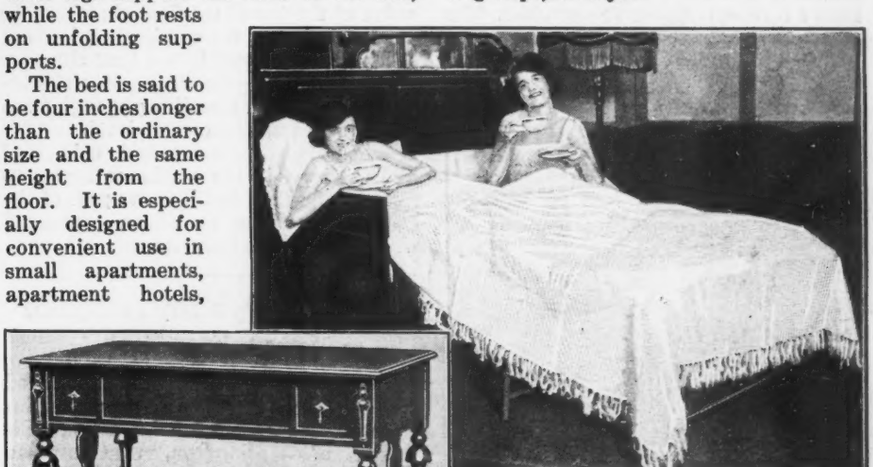
You simply place your shoe beneath a rotary brush at the base of the machine and insert a penny in the slot. The penny immediately operates a switch that starts an electric motor. The motor whirls the brush for a full minute while the customer adjusts his foot to the best advantage.

Studio Bed Folds into Attractive Table

A COMBINATION table and bed that makes two rooms out of one, is one of the ingenious new furniture combinations devised for the small home. It requires no wall space and can be used in any room. The double bed is complete, with springs, mattress, and bedding that, when folded into the table, are out of sight.

The table is an attractive piece of furniture for the living room, in the daytime, without betraying the slightest indication that it can be converted into a bed. When unfolded, the top of the table is raised to form the head of the bed. The table legs support the head of the bed, while the foot rests on unfolding supports.

The bed is said to be four inches longer than the ordinary size and the same height from the floor. It is especially designed for convenient use in small apartments, apartment hotels, or studios where space is limited. There is no need for a closet for bedding, since the table serves as a closet in itself.

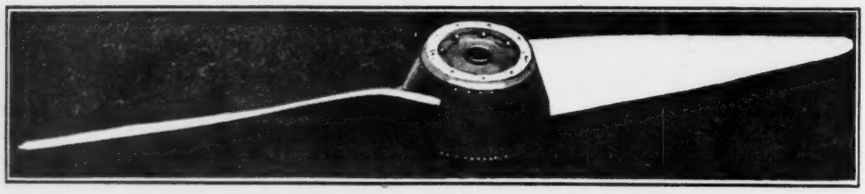


Above: The table unfolded to form a comfortable double bed for the small apartment. The top of the table is lifted upward to form the back of the bed. The foot rests on two sets of unfolded supports as illustrated

Folded into a table for daytime use

Dyed Shoes Poison Wearer

SHOES dyed with materials containing aniline or nitrobenzine will poison the wearer unless they are allowed to dry at least 24 hours before being worn, declares Prof. A. S. Lovenhart, chairman of the Department of Pharmacy at the University of Wisconsin. The person so poisoned becomes blue, particularly on the lips and fingertips, he says.



All-Metal Propeller for Airplane Safety

AS A result of experiments with sound vibrations, S. A. Reed, of New York, an expert in acoustics, has produced what is said to be the first successful all-metal propeller for airplanes. The inventor claims it is little affected by atmospheric conditions and assures greater safety to aviators.

The Reed propeller is of duralumin. Tests have demonstrated that, compared with a wooden propeller, it develops from two to five per cent greater efficiency in straightaway flying, and from three to 10 per cent in climbing. This is due to the fact that it is constructed of a single metal plate of uniform thickness, making it one working section.

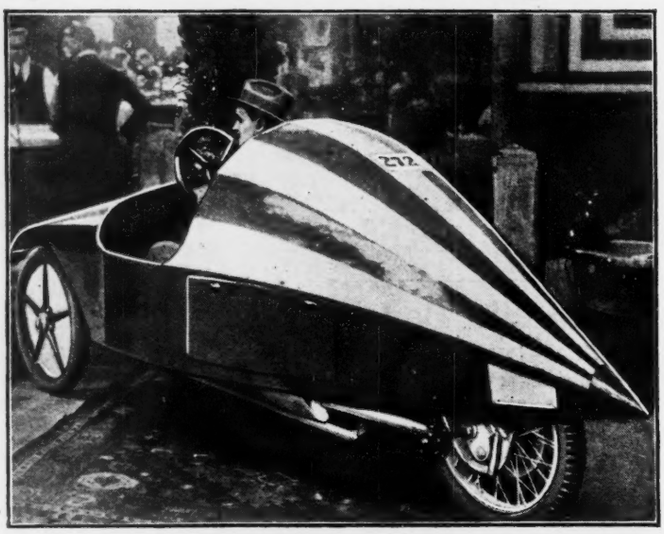
The danger of breaking a frail wooden propeller in flight always has constituted one of the principal hazards of flying. The duralumin propeller, it is claimed, can pass unharmed even through a hailstorm that would shatter a wooden propeller to bits.

Driver Sleeps in Three-Wheel Touring Car

NARROW roads, crowded hotels, or stormy weather would concern but little the motor traveler touring in this odd three-wheeled car, exhibited at a recent motor carnival in Germany.

The hood abaft the driver provides sleeping accommodations. The car has speed lines and is designed for cross-country touring.

Power from the small engine is transmitted to a single drive wheel at the rear.



The streamlined hood provides sleeping quarters for the driver

Automatic Oil Feed for Ford Crankcase

TO INSURE a proper level of oil in Ford crankcases, this device automatically feeds the fluid drop by drop from a three-quart reserve container. The oil is fed into the crankcase through a float chamber, containing a hollow metal float.

This float controls an oil intake check valve at the top of the float chamber. As the level of oil in the crankcase is lowered —lowering the level in the float chamber correspondingly—the float opens the intake check valve, permitting enough oil to enter to restore the correct level.

When the surplus supply is exhausted and the level in the crankcase begins to fall, a wafer float in the lower part of the chamber operates an alarm connected with the magneto terminal.

Demonstrating the automatic oil feed

Cheaper Dynamite Made from Sawdust

DYNAMITE that can be manufactured cheaply from sawdust has been invented by Prof. William M. Dehn, University of Washington, Seattle. He claims it will insure farmers of the Pacific Northwest a permanent and inexpensive medium for blasting stumps from logged-off lands.

The State Grange is reported to be making plans for the manufacture and distribution of the new powder.

Gas-Jet with Safety Valve Prevents Accidents

ACCIDENTAL asphyxiation is said to be impossible in rooms where gas-jets are equipped with a newly invented safety tip. So also are explosions of gas escaped from a jet carelessly left open. Gas can be released from the tip, even when the jet cock is on, only if a lighted match is held close to it. The action is automatic.

Match flame frees gas

An arrangement of fine wire, of a metal that contracts and expands markedly with temperature changes, controls a ball that blocks the outlet of gas. As long as this wire is cold, the ball will allow no gas to escape.

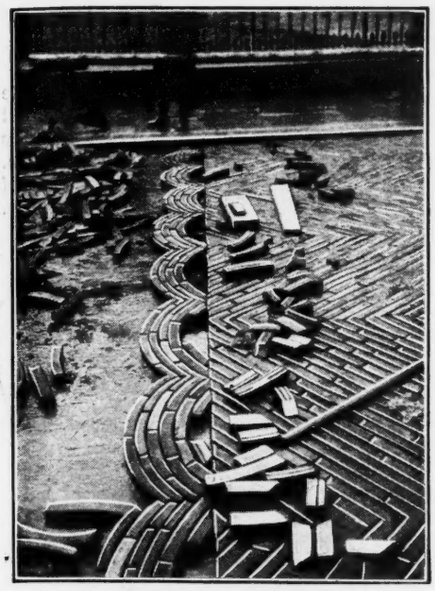
But if a lighted match is held near the jet tip, the heat will cause the wire to expand, pushing the ball from the narrow opening it blocks. The gas then rushes through the tip.

Portable Electric Motor Is Air-Cooled

USUALLY, when an electric motor is running, it is considerably too hot to be held uncovered in the hand. A newly perfected portable motor, however, is provided with a specially designed air intake that keeps it cool enough to prevent burning the fingers. It is shown in the illustration below operating an electric shaper on a jewel case.

This ingeniously designed little motor is said to develop one eighth horsepower and to run 8500 revolutions a minute under full load. Without a load, it runs 18,000 revolutions a minute. It is said to develop more power for its size than any motor before designed.

Air-cooled motor driving a shaper



Road Paved with Cast-Off Solid Rubber Tires

A ROAD surface of rubber blocks cut from discarded solid tires has been laid in Bradford, England, as an experiment. The stretch of paving is in front of a court house, the proximity of which to the street always has made the noise of passing vehicles particularly annoying. The cost of the pavement, it is estimated, was about $3.75 a square yard.

The rubber was stripped from the metal rims of the tires and cut into pieces about 2½ inches square by 11 inches long. The pieces are held in position with pitch or tar, as are the wood or stone paving blocks heretofore used.

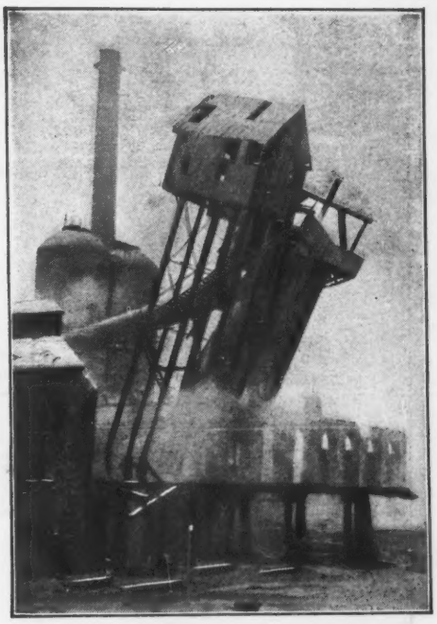
Compact Cabinetmaker Does Work of 10 Men

THE work of 10 men is said to be equalled by an unusually compact mechanical cabinetmaker, which requires only a one-horsepower motor. The machine is declared almost as versatile as larger machines designed for similar purposes.

The rip gage is used right and left, and also as a guard over the circular saw. The saw table will tilt to an angle of 45 degrees. A hand wheel adjusts the projection of the saw above the table.

Pressure rollers hold work firmly on the table when planing is being done.

Ripping stock with the circular saw



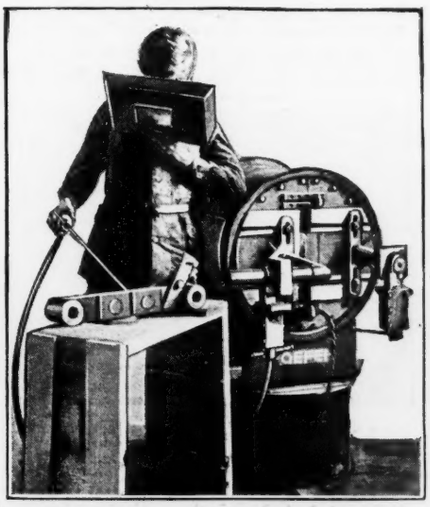
Old Blast Furnace Felled by Dynamite Discharge

TWENTY slender sticks of dynamite felled this blast furnace, said to have been one of the oldest and largest of its kind in the country, at Pottstown, Pa., when its owners decided that sectional dismantling would be too slow and costly.

Eight hundred tons of masonry tottered with a grotesque, lazy motion, then crashed with an earth-shaking roar.

A new furnace, embodying all modern innovations, will be upreared on the same spot.

The above photograph shows the towering structure just after the explosion.



Electric Machine Does Welding or Forging

THIS universal machine is said to combine an electric forging hearth, a butt-welding machine, a spot-welding machine, and an arc-welding machine. By turning the revolving portion, it is transformed from a spot-welding machine to a forging hearth. By inserting two plugs and attaching a lever, it becomes an arc-welding machine.

Alternating electric current supplies heat and power.

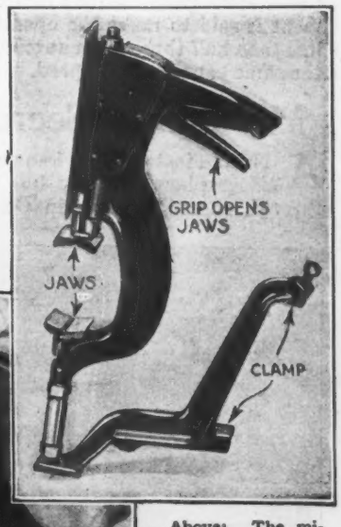
Gage Measures Rotating Work

TO PERMIT measuring work while it is being rotated in a grinding machine, Philip S. Arnold, of Flint, Mich., has invented an ingenious automatic micrometer gage.

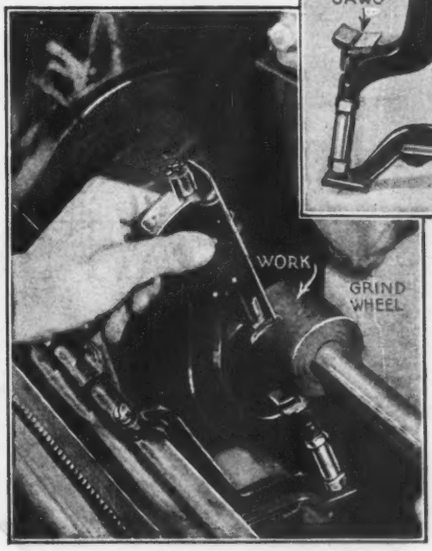
The gage, clamped to the bed of the grinder, is equipped with two jaws set so that an accurate measurement of the desired diameter will not cause any deflection of the recording needle. When the mechanic believes his work has reached the required diameter, he grasps the handle, depresses the entire arm and presses on the grip. This lowers the lower jaw and raises the upper jaw, thus permitting their adjustment so that the work is between them.

By releasing the handle, the upper jaw takes a definite position with respect to the lower one, according to the diameter of the work. If the previously set needle still registers zero, then the work is accurate.

The arm swings in a loose joint.



Above: The micrometer gage, showing clamp that holds it to the bed of the grinder, and the operating handle and grip



At the left: The gage jaws measuring the diameter of work while it is revolving in the grinding machine

Motorcycles Transformed into Mail Coaches

TO MEET the situation created by the suspension of rail service to many parts of Germany, because of the coal famine, the German post-office department has made over several hundred motorcycles into odd, three-wheeled cars of the type shown above. Besides carrying mail, they more than support themselves by conveying passengers.

The motorcycle motor, of four cylinders, gives the car a maximum speed of 35 miles. A second carburetor is built in front of the engine, which is exposed in front of the car. This carburetor uses a low grade of oil, which is preheated by the exhaust gases. Such a motor arrangement is said to make the operating costs less than half those of an automobile with the same capacity and speed.

The car accommodates the driver and five passengers. Mail and packages are carried on the roof in a railed inclosure where they are out of the way of the passengers.

Eagle a Model Husband

THE married life of the American bald eagle presents a model of constancy to the people of the land of which it is the symbol, according to Prof. F. H. Herrick of Western Reserve University. But when the eagle's mate dies, a new marriage is contracted and the new mate takes up its residence in the old nest, he explains. The same nest therefore may be used for a very long time by the successive members of the family partnership.

Floor Lamp and Talking Machine Combined

LIGHT and music are dispensed by the phonographic floor lamp pictured below. Removal of the top of the shade exposes the tone arm and record table. An electric motor beneath the fringe of the lampshade runs the talking machine.

The amplifier is a small rectangular chamber, in which passages are partitioned to resemble the mechanism of the human throat. The lamp bulbs under the fringe are lighted, as is usual, by pulling two silken cords. Plugging in the connection operates both lights and phonograph.

Power and light for the combination device are obtained through a wall plug.

Placing a record on the talking lamp

Mechanical Secretary Takes Telephone Calls

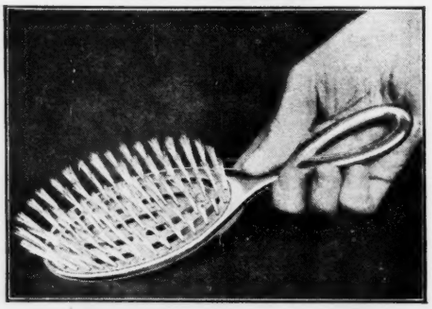
A NEW instrument known as the telegraphon, recently has been put through successful tests in Germany in taking and recording telephone messages automatically, in taking dictation and in recording minutes of meetings.

The machine combines the principles of dictating machine and the microphone. If a telephone call comes in during the absence of the one for whom the message is intended, the telegraphon acts as a secretary to take the call. Upon the return of the absentee, he places a pair of receivers over his ears, turns on the machine and hears the complete message.

When used in the office for taking dictation, the machine can be placed near the stenographer's desk in a distant part of the building while the dictator can remain seated at his desk.

By the use of a microphone in the dictator's office the sound of his voice can be amplified sufficiently for transmission over the wires to the machine. This permits several people to dictate to the same stenographer.

Above: Listening to a telephone message recorded and repeated by the mechanical secretary. At the right: The business man dictates a letter into a microphone on his desk, to be received and typed by a stenographer in another room



All-Metal Hair-Brush Is Easy to Keep Clean

THIS hair-brush is entirely of metal, the back and handle of aluminum and the bristles of fine, silvered steel wire. Strange as it may seem, the metal bristles are said to give a delightfully smooth sensation to the scalp.

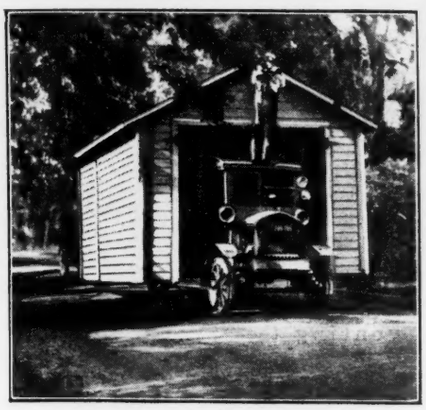
The back of the brush is perforated with slots which, besides giving extreme lightness, make it easy to clean. A brief bath of boiling water is said to cleanse the brush thoroughly.

The makers claim the brush will last a lifetime, since it is unaffected by moisture, and that the effect of the wire bristles is beneficial to the scalp.

Motor Truck Moves Garage a Mile on Its Back

LIKE a grotesque member of the tortoise family, this motor truck recently traversed the streets of Ypsilanti, Mich., carrying a garage on its back. In this way the structure was moved more than a mile, resting on timbers placed across the frame of the car.

The garage was lifted by jacks.

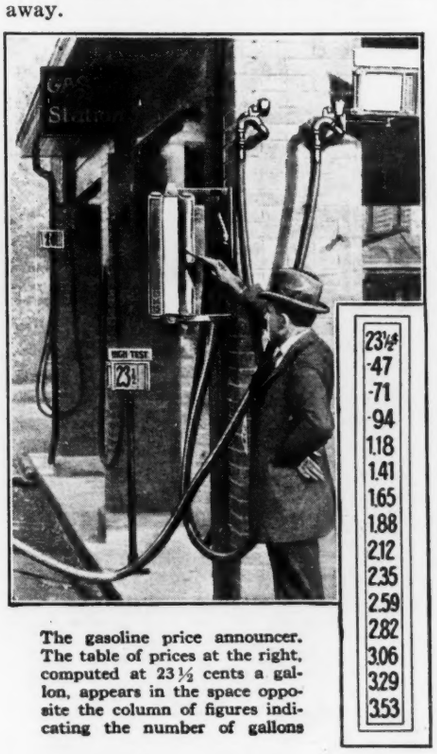


Moving the garage by motor truck

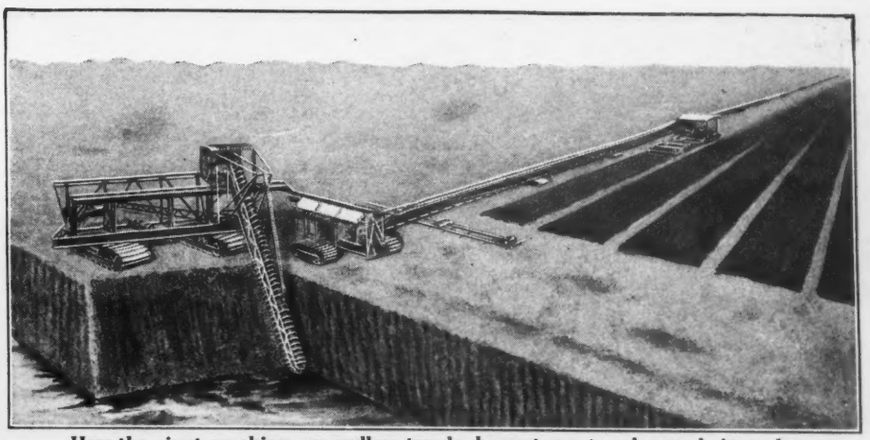
Filling Station Computes Gasoline Bill

THE quoted price of gasoline a gallon, according to grade, as well as the total cost of any specified number of gallons (from two to 15) at that price, are displayed for automobilists by a newly patented price semaphore for filling stations. The twist of a key automatically alters the figures according to price changes.

The device has a price range of from 15 cents to 25 cents a gallon, including half-cent gradations. It is easily and quickly attached, and the numbers can be read by a motorist seated in his car 10 feet away.



The gasoline price announcer. The table of prices at the right, computed at 23½ cents a gallon, appears in the space opposite the column of figures indicating the number of gallons



How the giant machine, on endless treads, harvests peat and spreads it to dry

Machines to Harvest Vast Canadian Peat Bogs

NEARLY 40,000 square miles of peat bogs, from five to 10 feet deep, soon will be harvested in central Canadian provinces that, because they lie too far from the Dominion coal areas, have depended upon United States mines for fuel. To accomplish this, the Canadian government has spent nearly five years of research and more than $300,000 developing machinery and a digging and drying system.

The process consists of excavating, mixing, grinding, and finally spreading the peat on a drying surface in cut blocks. In from 30 to 40 days the fuel is sufficiently dried. The plant consists of four specially devised machines—an excavator, a belt conveyor, spreader and harvester.

The excavator is a steel frame on endless treads, supporting digging buckets moving on an endless chain. The excavator can be adjusted to cut any desired depth and is highly mobile because of its ingenious caterpillar base. Only two men are required to operate it.

The conveyor is 860 feet long, of fabricated box girder in 10 sections, also mounted on endless treads. A belt conveyor runs through the box, carrying the peat to the treating mill. From the mill the belt conveys it to the drying fields.

The spreader, also moving on endless treads, runs parallel and near to the conveyor. The spreader has an extended hopper that is fed from the conveyor.

The entire plant thus moves as a single unit on endless treads, cutting the peat and leaving full drying fields behind it as it advances.

Fruit Made Sweeter by Sealing Up Cores

BY SEALING up the blossom end of apples, pears, quinces, and crab-apples, sweeter and better flavored fruit can be produced and "core rotting" retarded, according to Prof. Brooks D. Drain of the Massachusetts Agricultural College.

Since the core acts as a ventilator, the chemical changes that accompany ripening occur most rapidly in the core part, resulting in decayed centers, he said. Closing the ventilator preserves the core.

This Player Piano Is also a Banjo Instructor

FAIR proficiency on a mandolin, banjo, ukulele, or similar stringed instrument within a few hours is a result claimed by the inventor of a new player-piano music roll, which acts as a mechanical music teacher.

It differs from the ordinary roll in that along the left margin, at varying intervals, are printed diagrams representing the upper section of the fingerboard of the instrument being played. On each diagram are printed numbers in circles, indicating where the fingers corresponding to the numbers are to be placed in order to produce a chord that harmonizes with the piano music.

The player first tunes the instrument to the piano. Then he starts working the treads of the piano. As the first diagram comes into view, he places the proper fingers on the designated frets and strums. Each new diagram indicates a change in the chord. The words of the song are printed along the right margin, as on the ordinary roll.

Several beginners can practise together.

On the music roll appear fingering diagrams for banjo or ukulele

Tractors Take Job of Elephants in India

THE teak-piling elephants of India, remembered by Kipling in "Mandalay," are threatened with extinction by the inexorable efficiency of man's mechanical servants.

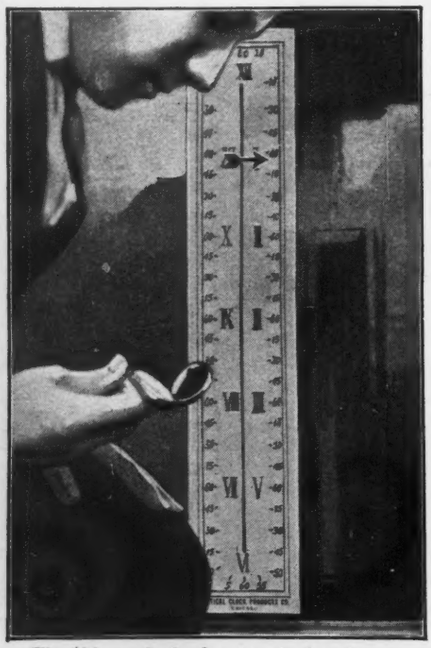
One of Burma's largest lumber companies, after careful and extensive tests, has adopted American endless tread tractors to pile the teak logs. The machines are declared to be far cheaper to house and feed than the vast, leisurely elephant and to pile many more logs a day. Moreover, they are by no means so temperamental.

"Thermometer Clock" Has only One Hand

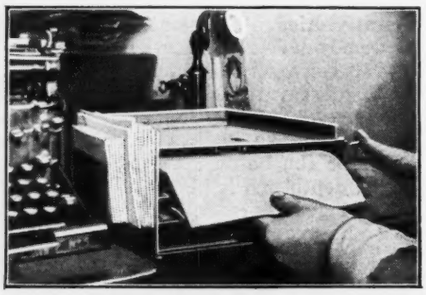
RESEMBLING a thermometer, an oblong clock with a single hand is the latest innovation in timepieces.

The space between each hour number is divided into minute units. Smaller figures mark the 15-minute periods. A pointer traveling in a slot between the columns of figures, is attached to an endless chain actuated by a mechanism at the bottom of the case.

When the pointer reaches the bottom, it turns and starts upward, pointing in the opposite direction.



The oblong clock, showing single pointer



Paper Cabinet Saves Time for the Typist

THREE sheets of paper, one for the original letter, one of carbon paper, and one for the copy, are presented a stenographer in the proper order and position at a touch of the lever on this newly patented cabinet.

The usual way of storing these papers in the drawer of a desk often crumples or soils an expensive quantity. This is particularly true of carbon paper. Often, too, the typist attempts to use a slightly spoiled sheet, not noticing the defect perhaps until she has completed a letter.

The Sea's "Cold Wall"

WHERE the Gulf Stream and the iceberg-laden Labrador Current meet off the Grand Banks of Newfoundland, extreme differences in the temperature of the sea water often are observed over short distances. This dividing line is known as the "cold wall."

While on ice patrol duty, a United States coastguard cutter found itself across the "cold wall." The water temperature at the bow was found to be 34 degrees, while that at the stern was 56 degrees.

Case for Medicine Bottle Prevents Spilling

HAVE you ever opened your trunk or suitcase at the end of a journey to smell a strong odor of medicine and see a brown or yellow stain straggling across some of your choicest possessions? This newly patented metal case is designed to prevent just such a catastrophe.

The top of the metal case grips the bottle stopper. Behind a cork disk in this top is a small spring. When the top is snapped into place, it holds in the stopper securely, preventing the contents from leaking and doing damage.

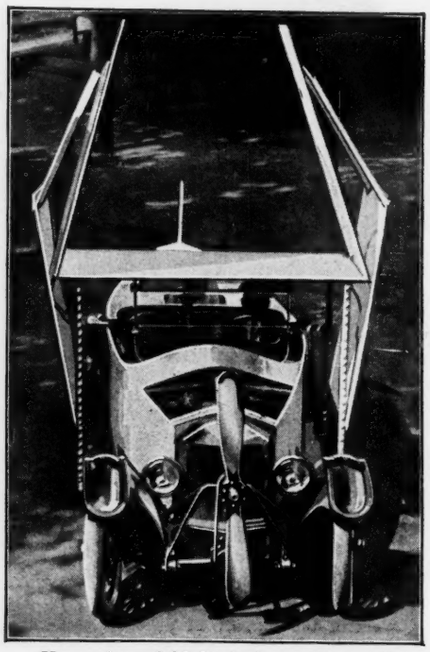
Cap holds the stopper

Automobile and Airplane Combined in Model

TO DEMONSTRATE his idea of a combination automobile and airplane which, he hopes, will soar in the air as safely as it will travel the roads, John E. Longenecker, of Lititz, Pa., has built a model of his proposed machine, as shown below.

On a standard auto roadster he has mounted airplane wings of the Curtiss biplane type, arranged so that they will fold when the machine passes along narrow roads.

An ordinary airplane propeller is mounted in front of the radiator and is driven by belt and pulley from the front of the crankshaft. The transmission mechanism is such that power from the engine can be made to drive either the rear wheels or the propeller.



How wings fold back for road travel

An Electric Flashlight without a Battery

A SMALL electric flashlight that is said to require no battery, is lighted by hand operation of a spring lever on the side. It is designed for sportsmen, campers, motorists and watchmen, and for home use. It weighs only 12 ounces and is less than five inches long, fitting easily into the pocket. Since there is no battery to deteriorate, it requires no renewal.

Lever runs a magneto

Pressure of the fingers on a lever spins a magneto within, generating electricity. The spring returns the lever for another squeeze.

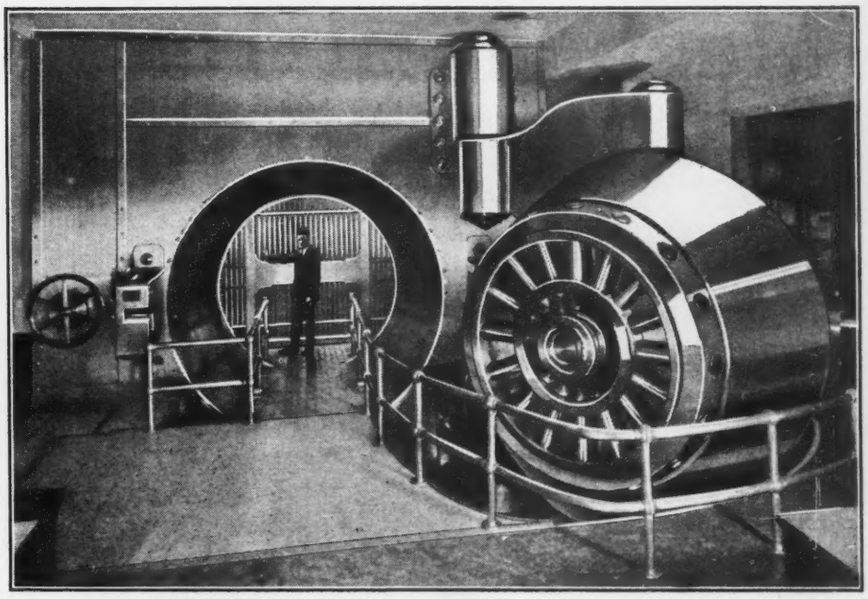
The case is said to be waterproof so that it cannot tarnish or rust.

Safety Goggles Attached to Eyeglass Rims

THE machinist whose eyes require glasses and whose job requires goggles for safety usually finds himself between disagreeable alternatives. Ordinary goggles cannot be worn satisfactorily with glasses. So either he must forego safety for clear vision, or he must forego clear vision for safety. The latter choice often is impossible.

The recently patented type of goggles shown above now permits him to use glasses and goggles simultaneously. Each glass is separate and snaps on the frames of standardized 1 9/16-inch spectacles. The attachment is effected by a little clip on the inside of the goggle cup. This clip is said to hold with a bulldog grip, fastening the goggles securely.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.



Largest Bank Vault Door Four Feet Thick

SAID to be larger than any other door of its kind in the world, a giant bank vault door four feet thick, made of solid steel, recently has been installed in Cleveland, Ohio.

The total weight of the entrance is 195 tons. Weight of hinges alone on the door is 40,765 pounds, exclusive of bolts. The outside diameter of the door is 124 inches and the inside diameter 90 inches.

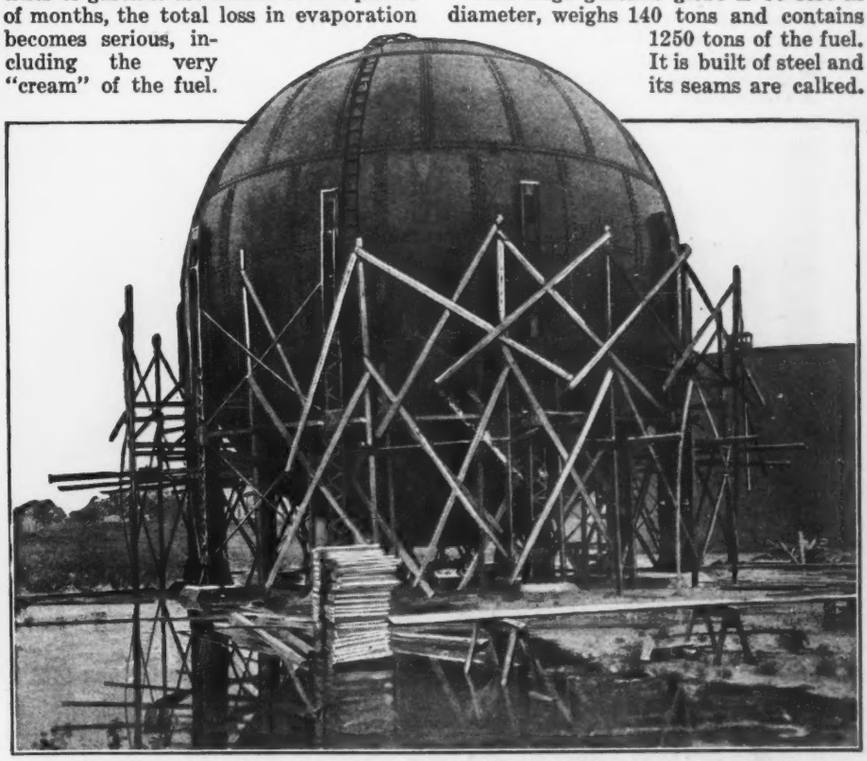
So delicately adjusted is the mechanism of the door on its roller bearing, and so accurately is it designed that it can be swung easily by pressure of the hand.

Ball-Shaped Gasoline Tank to Reduce Waste

BUILT in the form of a giant metal globe, a new type of storage tank for gasoline is designed to eliminate the losses resulting from the partial evaporation of the fuel. Such wastage is said to be unavoidable where the ordinary cylindrical tanks are used. Evaporation, by removing the most volatile part of the gasoline, degrades it. Where large quantities of gasoline are stored over a period of months, the total loss in evaporation becomes serious, including the very "cream" of the fuel.

The new tank is constructed on the theory that such a shape distributes internal pressure most evenly, variations in pressure being the most potent cause of evaporation. In the ordinary closed cylinder, the stresses due to pressure on the bottom are duplicated on the top, giving an end-to-end stress double the circular stress.

This huge gasoline globe is 50 feet in diameter, weighs 140 tons and contains 1250 tons of the fuel. It is built of steel and its seams are calked.



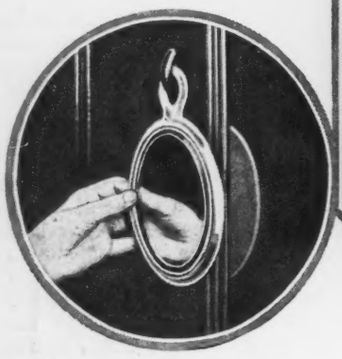
The huge globe-shaped gasoline tank built of steel, nearing completion

Mechanical Hands to Make

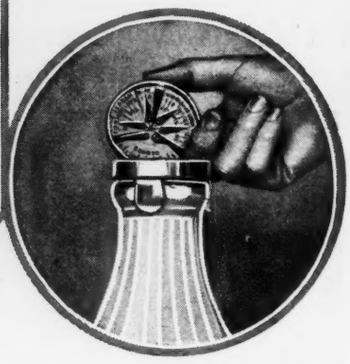
Liquids cannot boil over, it is said, if this metal plate is placed, hollow side down, on the bottom of the vessel. The energy of boiling is controlled

A handy type of electric dishwasher can be wheeled to the dining-room table for removal of dishes. When attached to the kitchen faucet a stream of clean water courses among the dishes, which are dried by warm air circulated by an electric fan. A wall plug supplies the power

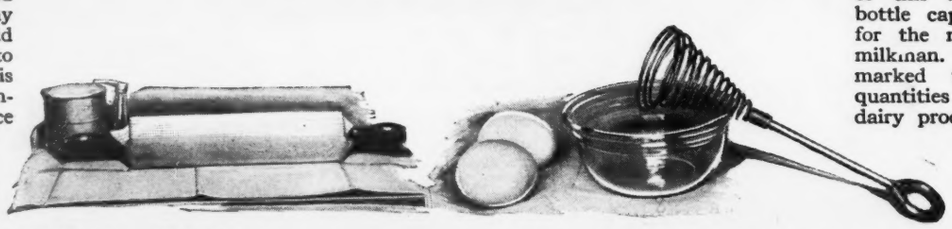
An alarm bell rings when a refrigerator drip pan equipped with this device nears the overflowing point. The bell is actuated by a float that rises with the water. The alarm is wound by hand



A rubber vacuum hook that can be attached by suction to any smooth surface is said to support loads up to 20 pounds. Since it is of solid rubber, it cannot injure the surface

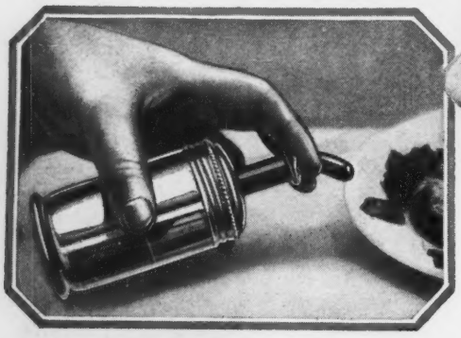


Six pointers on the dial of this metal milk-bottle cap substitute for the note to the milkman. The dial is marked to indicate quantities of each dairy product desired



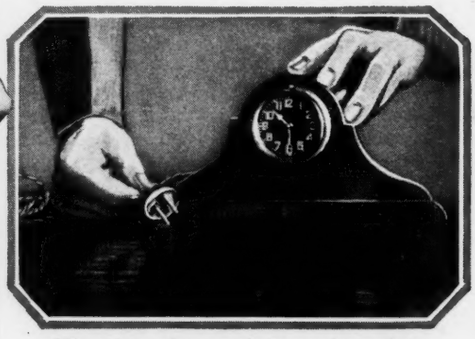
Dough will not stick to the rolling-pin, it is claimed, when this knitted cover is pulled over it and rubbed with flour. The cover can be removed and washed

Only one hand is required to operate this egg-beater. The alternate compression and recoil of the spring are said to beat up the eggs thoroughly



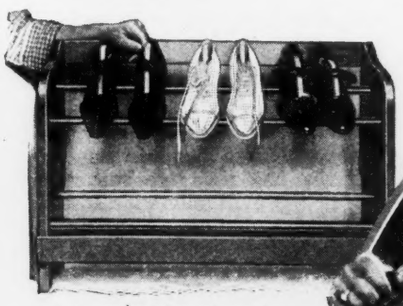
A sanitary mustard jar. Pressure on a finger grip ejects mustard in the quantity desired through a hard rubber stem. No spoon is required

Two electrically heated rods over which the hair is wound in a figure eight are said to produce in half an hour an attractive wave that will last its wearer for 10 days



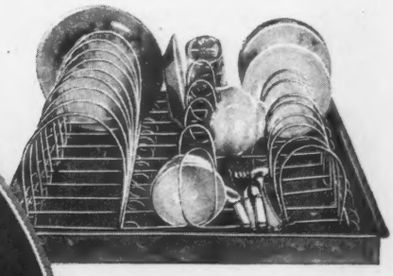
Electricity from a light socket winds this clock. When it runs down, an automatic mechanism releases enough current to wind it up once more

Light Work for Housewives



Fitting snugly against the baseboard in bedroom closets, this compact shoe rack is designed to meet the problem of accessible room where footwear can be stored undamaged

Heat in this new electric cooker is controlled automatically. All steam from cooking food is caught and condensed in the dome-shaped top



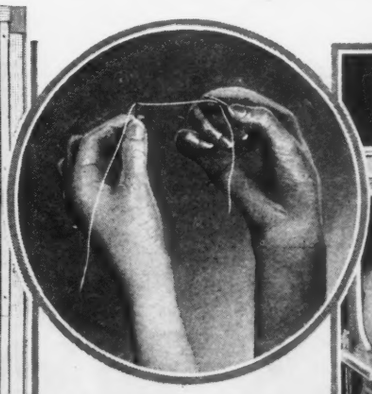
A drying-pan such as this banishes the dishcloth. Surplus moisture from washed and scalded dishes drips into the pan while the dishes dry. Racks of various sizes are provided

A midget electric heater that can be hung by a hook wherever a wall plug is available, is handy for such purposes as drying a few clothes as well as for warming a spare room

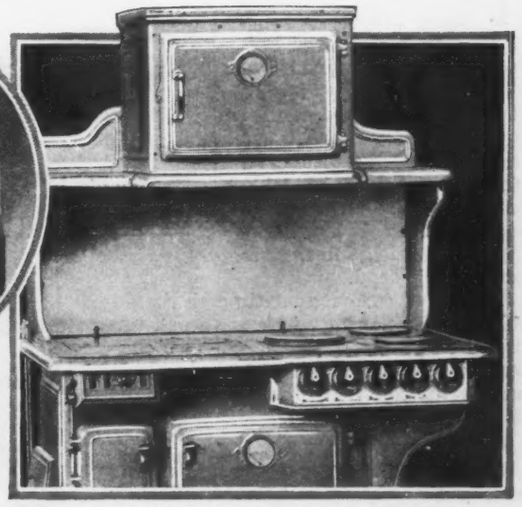
To protect the housewife's hands, these wooden safety tongs will lift clothes from the tub of scalding water or feed clothes to the wringer

A broom of any size fits into this holder consisting of a metal shoulder opposite which is a pivoted wooden block with a point that pinches the broom handle as the weight of the broom pulls downward

This compact gas-heated clothes-dryer is said to insure against the escape of fumes and to require no chimney connection



Threading a needle is simplified by a device with a tiny notch that is thrust through the eye. The thread then is looped into the notch and drawn through the eye of the needle



The invention of a combination electric and coal range assures the housewife a cool kitchen in summer and a warm one in winter

Residence District Invaded by a Coal Mine

WITH dynamite, steam shovels, and locomotives, a coal company is following a rich vein of coal, only 10 feet below ground level, into the residence district of South Scranton, Pa.

A straggling, ugly excavation gnaws to the very back stairs of the houses. And, despite repeated and violent protests from property owners to state and federal authorities, the mining operations continue.

For some years it has been known that Scranton is built upon ground which is rich in coal deposits.

Heated Box Is Substituted for Bedclothing

How the lighted box covers sleeper

REPLACING sheets, blankets, and quilts with a box open at each end and heated by four 40-watt lamps, Milton Fairchild, of Washington, D. C., believes he has rediscovered one of the hygienic principles which enabled primitive man to be rugged without doctors.

Air holes in the box supplement the ventilation afforded by the open ends. The sleeper's head remains outside. A blanket draped from the upper end of the box to his shoulders keeps the room in the darkness necessary to prompt and restful sleep.

The lights supply warmth and, the inventor believes, many of the therapeutic values of sunlight. He is convinced that many ills are due to heavy bedding.

Electric Flashlight Blown like a Whistle

THIS electric flashlight never will go dark because of an exhausted battery. It hasn't any battery. The user lights it by blowing through a mouthpiece. The inventor claims it cannot deteriorate by disuse, a feature making it a valuable convenience about the home. Often when a flashlight is needed most, it is found to be dead.

The wind current sent through the device by the blowing revolves a small turbine that generates electricity. Two magnets, one on each side of the turbine, gather the electricity thus generated and it is carried to the lamp.

The turbine flashlight

How the light is used by a cyclist

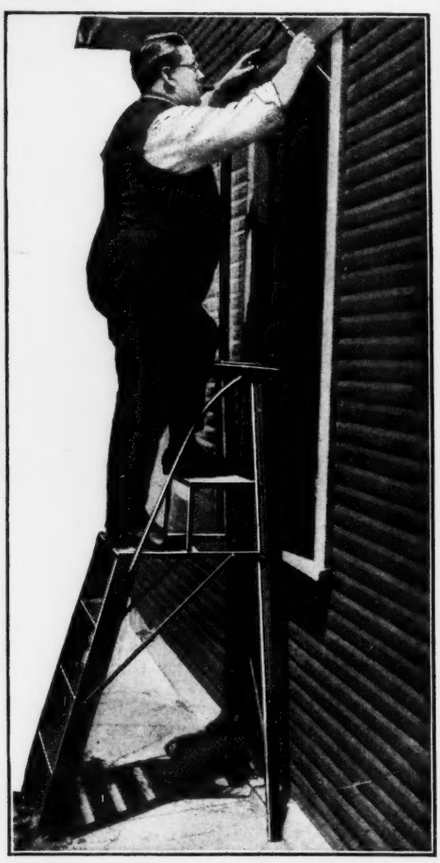
ABOUT 7,500,000 pounds of picric acid, a surplus war explosive, has been used by farmers in this country to clear 250,000 acres of land and clear stumps from 86,000 acres in cultivation.

Home Stepladder Designed for Sure Footing

THE stepladder commonly used about the house for such tasks as putting up window screens, hanging pictures, and painting window frames has been the cause of many a bad spill because of its uncertain support.

To insure against the possibility of such accident, a Chicago inventor has devised a ladder that he claims gives sure support because of the unusually wide spread of the legs and a double bracing arrangement, preventing tipping or uneven balance.

In addition, the ladder is provided with two wide steps at the top, affording adequate footing and greater assurance of security for the user.



The safety ladder, showing wide steps

Iron Rust Costs Nation Billions Each Year

RUSTING of iron and steel costs the United States about $3,000,000,000 a year, according to a report recently made by J. Vipond Davies, president of the United Engineering Society, based on researches extending over a period of 12 years.

Investigations revealed that sea water, water in alkaline coils, or water percolating through "fills" containing some kind of chemical wastes are the most common assailants of iron. They are discovered in the piping of water and sewage systems, tunnel linings, and similar structures.

Certain kinds of soil and water also act upon cast iron, slowly softening the metal until it can be cut with a penknife. Strange to say, iron thus softened becomes hard again when exposed to the air.

Game Scoring Simplified by Scientific Method

SCORING a game becomes a sort of pleasure with an ingenious set of counters recently devised. At a glance, the scorer knows just how many counters of each color each player has, and how many of each color remain undistributed in the box.

Similarly, the player knows from a glance at his rack of counters how many of each color he has left. The rods prevent his stack from being knocked over.

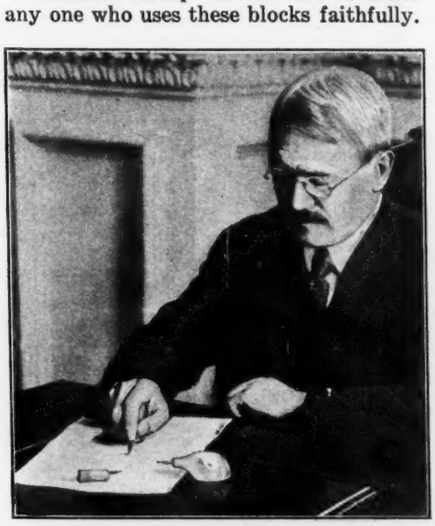
Each rack has four rods, and each rod is graduated so that a number, indicating how many counters remain, always is visible just above the top chip. Each rack has a separate letter. In addition, there is a counting board, with letters corresponding to those on the racks and with holes in which pegs are inserted to indicate the number of counters issued each player.

The counter racks and counting board

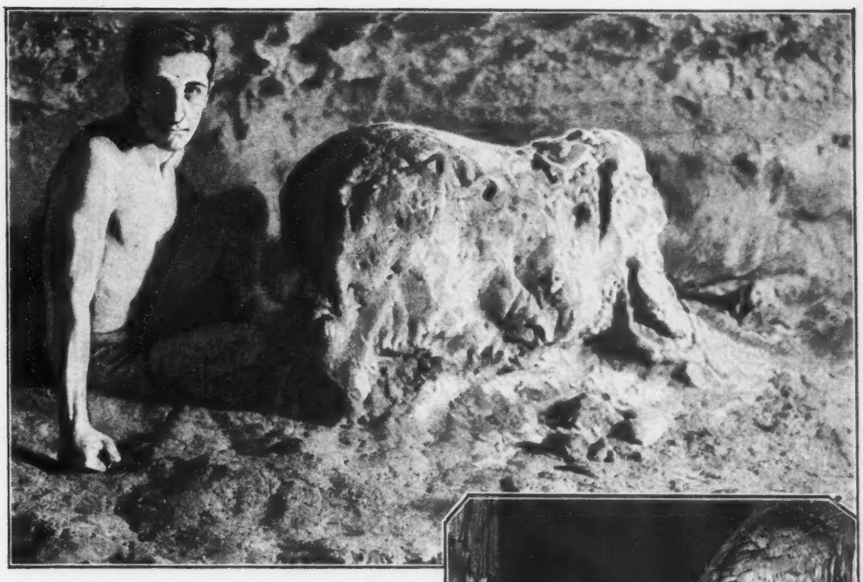
Wood Blocks Shaped to the Hand for Penholders

THE ordinary penholder is a needlessly uncomfortable device, according to Paul Vosburg, a German inventor, who has contrived various sizes and shapes of wood blocks for the same purpose. These are short and thick, with indentations to fit the fingers and palm of the hand. The pen points are inserted in the block in the same manner that they are fitted into the ordinary penholder.

"Writer's cramp" is said not to afflict any one who uses these blocks faithfully.



Writing with wood block penholder



Norbert Casteret, young French scientist and swimmer, sitting beside a prehistoric model of a bear discovered by him in a watery cave in the Pyrenees. At the right is a cavern view

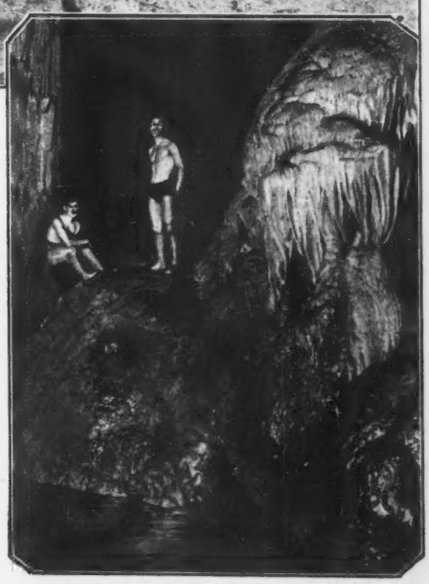
Swimmer Finds Art and Writing of Cavemen

IN A 1300-foot cavern at the heart of a high, wooded foothill of the Pyrenees, Norbert Casteret, a young French archeologist, of Toulouse University, recently found what are perhaps the most remarkable specimens of prehistoric art ever recovered, estimated to be 25,000 years old.

A subterranean stream flows through the cavern, winding through halls and passages that lead back into the bowels of the hill. In many places the roof of the cave dips down into the water, forming a barrier that for centuries has guarded the prehistoric secrets from the curiosity of science. Uncertain as to how long these submerged stretches were, no one ever had had the courage to swim through them.

M. Casteret, one of the ablest swimmers in France, determined to undertake the submarine journey. Carrying a candle and matches in a rubber case, he plunged into the watery cavern, diving deep where the rocky roof descended below the waterline.

After swimming nearly a mile he reached a dry gallery about 250 feet long.

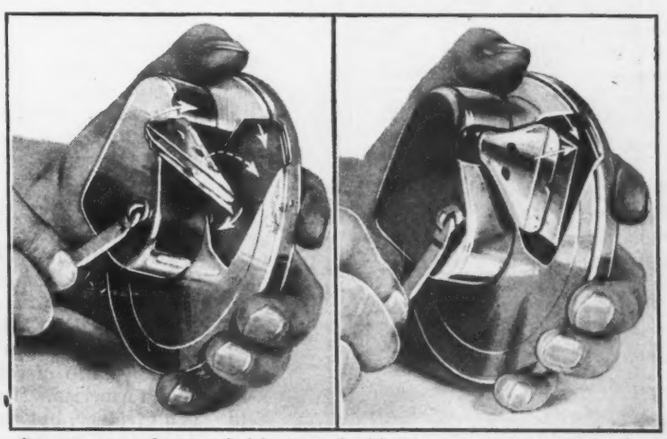


On the walls were engravings, made by flint instruments, of prehistoric animals—bison stags, mammoths, reindeer and wild horses. Also there were clay statues of animals, a large one of a bear and some 20 smaller ones, mostly of horses, badly mutilated by the drip of water from overhead.

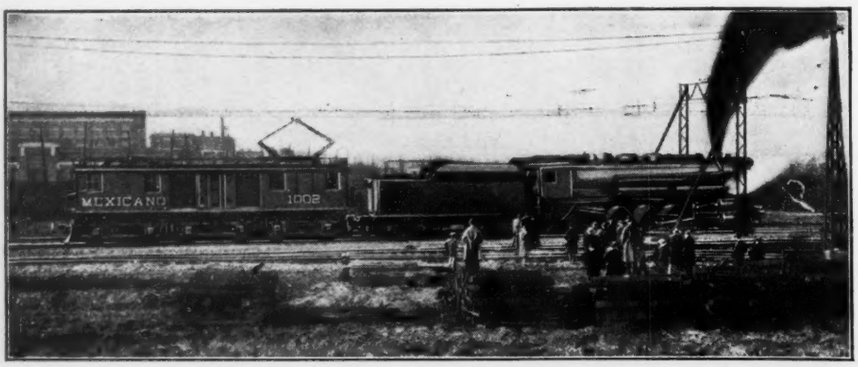
A clay figure of half of a woman's body and some statues of tigers were found near by. Crude mural engravings, fingerprints, the claw marks of bears and mysterious red ochre symbols marked the walls—prehistoric records of inestimable value.

Safety Razor Sharpener Operated by Crank

TURNING a small crank of this unusual safety razor sharpener automatically strops both sides of the blade. The crank revolves a honing disk and at the same time brings one side of the blade into contact with it, then the other. Thus, at every second turn of the crank the blade is completely swung around and turned.



At every second turn of the crank the blade is reversed as shown above



Electric Locomotive Victor in "Tug-of-War"

IN A "tug-of-war" between an electric locomotive and a steam locomotive, during a recent test by the General Electric Company at Erie, Pa., the electric had its way, pulling backward its unwilling antagonist, throttle open for full speed ahead, for a distance of half a mile.

They were fit rivals. The electric victor is perhaps the most powerful of its kind ever built, and its steam opponent is one of the New York Central's mightiest. Picked crews directed them.

The steam locomotive was allowed to start before the electric's engineer touched his power lever. Almost immediately after he did so, the pair came to a slow stop. Then, straining in protest at every joint, the humiliated steam giant began to move backward, pulled by its smaller adversary.

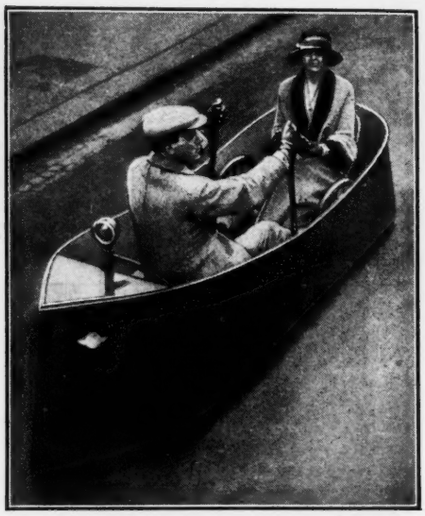
A valuable feature of this latest of electric locomotives, built for the Mexican Railway Co., Ltd., is its ability to generate power and feed it to the power line when it is running downhill. This feature also brakes the train.

This was demonstrated strikingly a few moments after the tug-of-war, when the steam locomotive was allowed to pull the electric one, the latter having its regeneration equipment ready. The pull corresponded to the impetus of a down grade and caused the electric locomotive to feed back into the power line a good part of the energy created by the steam engine's pull.

Odd Land Boat Rowed by Oarlike Levers

PROPELLED by two oarlike hand levers, and guided by a steering wheel at the rear that controls a single front wheel, an odd land rowboat is said to move at a speed considerably faster than a walk.

The two levers are geared to two rear wheels. A single pull on both levers is said to propel the car the distance of several strides.



"Rowing" the land boat with levers

Ride Side by Side on Odd Tandem Bicycle

MOUNTING this unusual two-seated bicycle is the hardest part of riding it. But, once the riders are up, side by side, they are driven by four legpower, resulting in greater speed and cruising radius than with the ordinary bicycle.

Balancing is said to be no more difficult than with the old-style front and rear seat tandem.

Riding two abreast on the bicycle

He Counts Dust Particles in the Atmosphere

COLLECTING and counting dust particles from the air for the United States Weather Bureau is the daily specialty of J. F. Hand, government scientist. His instrument, shown above, also has been used on airplane flights to determine the dust content of air at various altitudes.

Particles captured vary in diameter from .0002 mm., a size barely discernible under the microscope, to .0015 mm.

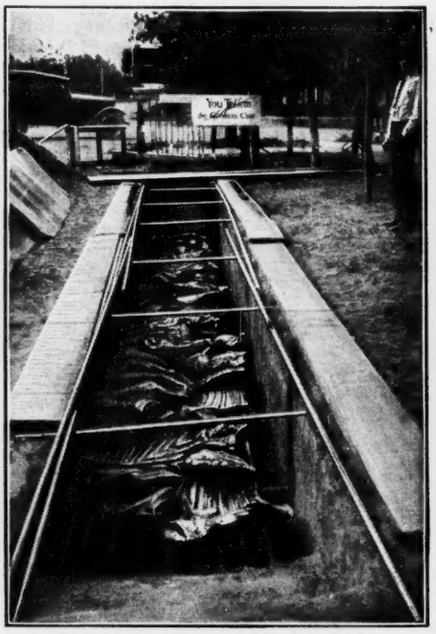
Frog Carries Its Young

A FROG of the Andes Mountains that carries its helpless young in a pouch on its back, Indian fashion, was discovered by Dr. C. Kingsley Noble, of the American Museum of Natural History during a trip of scientific exploration to South America. How the pouch is formed is a mystery, but there the little tadpoles dwell until ready to battle with life.

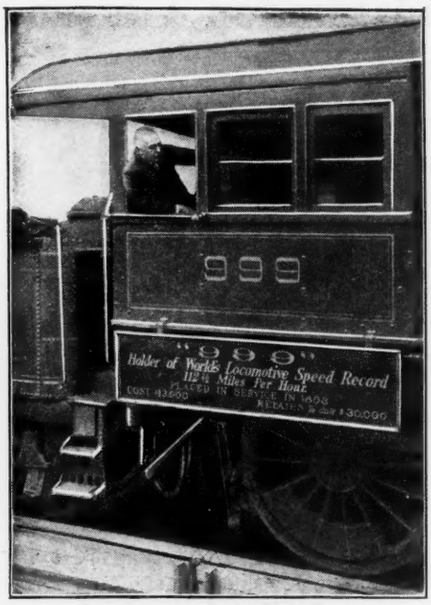
Electric Barbecue Cooks 2000 Pounds of Meat

ELECTRICITY cooked four 500-pound steers for crowds that attended an old-time barbecue at the annual Ephrata Roundup, at Ephrata, Washington, recently.

In an open pit 32 feet long were suspended 12 heating elements, each of three kilowatts capacity. About 180 feet of iron wire were required for each element. Sheet iron deflectors were installed. Bars to hold the meat were placed 18 inches above the deflectors.



Barbecuing steer meat by electricity



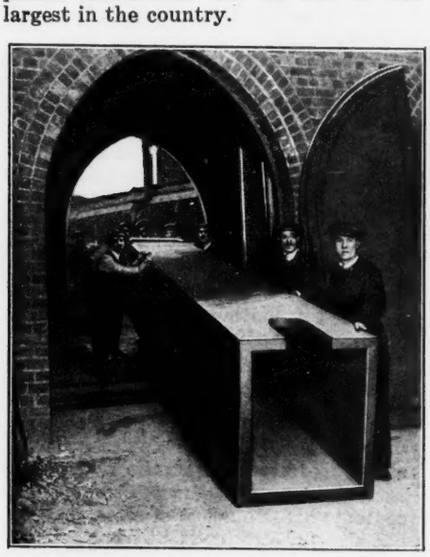
Thirty-Year-Old Engine Holds Speed Record

OLD "999," queen of locomotives and holder of the world's speed record for her kind, had her moment of glory recently at the railroad exposition in Grand Central Terminal, New York City. A. H. Smith, once her proud engineer, now president of the New York Central lines, is shown above at her throttle.

The old speed queen was placed in service in 1893, 30 years ago. For years she pulled the Empire State Limited, the fastest New York Central train, exactly on schedule. One day she was given full steam and a wide-open throttle. She responded with 112½ miles an hour, a record. It has stood since then. She was retired some years ago.

Giant Organ Pipe Weighs More than a Ton

AN ORGAN pipe weighing more than a ton was installed recently in the instrument being built in Liverpool Cathedral, England. The pipe is 33 feet long and three feet in diameter. The completed instrumeut will be one of the largest in the country.



Workmen moving the giant organ pipe

Recent Publications

A résumé of new books on science and invention

Wireless of Today, by Charles R. Gibson, F.R.S.E., and W. B. Cole, A.M., I.E.E. A non-technical explanation of the principles upon which wireless works and a description of the growth of wireless telephony and telegraphy from their inception until today. Illustrated. J. B. Lippincott & Co.

Personality of Plants, by Royal Dixon and Franklyn E. Fitch. A popular botanical work, describing the wonders of the plant world in terms that express an analogy in human activities. Illustrated. Boullion-Biggs.

Everyone's Book of the Weather, by A. Francon Williams. A concise guide for the amateur weather prophet. Illustrated. The Macmillan Company.

Weather Proverbs and Paradoxes, by William J. Humphreys, Ph.D., of the United States Weather Bureau. Ingenious application of the well-known weather adages and saws to scientific forecasting. Illustrated. Williams & Wilkins Company.

Henley's 222 Radio Circuit Designs. Written and edited by a large staff of radio experts. A handbook for the radio experimenter. Illustrated. Henley Publishing Company.

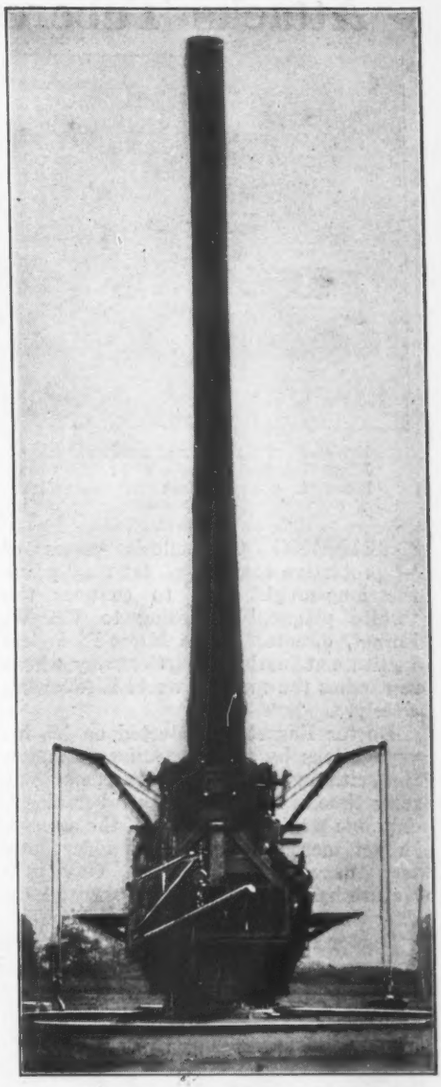
Science and Human Affairs, by Winterton C. Curtis, professor of zoology, University of Missouri. A comprehensive exposition of the humanistic aspects of the natural sciences. Illustrated. Harcourt, Brace & Co.

The Atom and the Bohr Theory of Its Structure, by H. A. Kramers, University of Copenhagen, and Helge Holst, Royal Technical College of Copenhagen, with a foreword by Sir Ernest Rutherford. Illustrated. Gyldendal (London).

Famous Pianist Invents Recording Mechanism

A VEIN of inventive genius accompanies the artistic talent of Josef Hofmann, the noted pianist. This genius he has directed successfully at the problem of recording music on reproduction rolls.

The invention with which he is pictured above records the delicate touch of a pianist's fingers with such unerring fidelity that, it is said, no hand corrections on the master roll are necessary. Such hand corrections always have been costly, sometimes almost prohibitively so, and always have fallen short of precise faithfulness to the original.



Uncle Sam's Greatest Gun Shoots 23 Miles

A MONSTER cannon, capable of hurling a 1560-pound projectile 23 miles, has been developed by the U. S. Ordnance Department. The famous Krupp gun that bombarded Paris during the Great War fired farther, but its missiles were much smaller.

Moreover, the new American gun, 14 inches and of 50 caliber, can be mounted on railway carriages. This mobility makes it far more deadly for most practical military purposes.

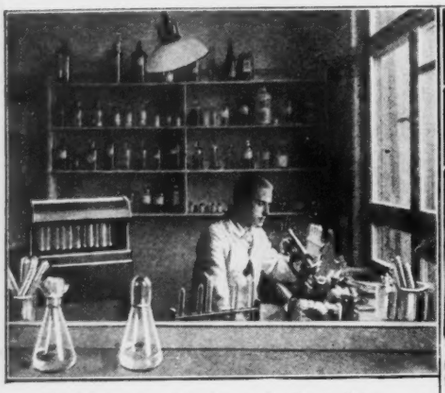
The great gun is shown elevated at an angle of 50 degrees. High elevations are necessary in firing such weapons because the trajectory of a projectile is an arc, whose center is high.

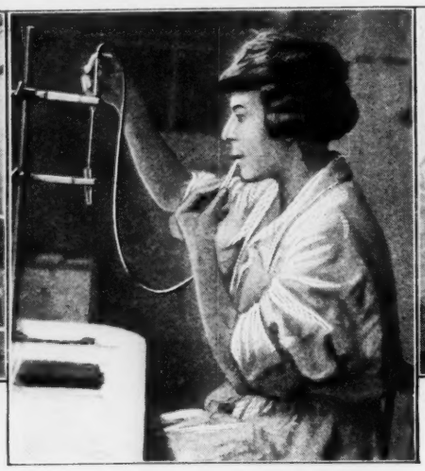
Red Men Prefer Red Color

THE red man's fondness for color is well known, but it has remained for Dr. T. R. Garth, of the University of Denver, to ascertain scientifically the color preferences of Indians in the Southwest.

Full-blood Indians prefer red to all other colors, then blue, violet, yellow, and white in the order named. White men, living in the same social and educational environment, preferred blue, then green, and then red.

Attacks Tuberculosis by Uncovering Hidden Germs





Dr. W. Fornet, founder of the Saarbrücken Micro-Biological Institute, who recently has launched a new attack on tuberculosis

Above: Tapping drops of blood from a boy's ear lobe for the Fornet test for tuberculosis. At left: Making the blood test

STRIPPING tuberculosis germs of protective coatings of fat may prove the long-sought way to conquer the "white plague," according to Dr. W. Fornet, director of the Micro-Biological Institute at Saarbrücken, Germany, whose researches the medical world is following closely.

Doctor Fornet was started on his investigations by the long-known paradox that, although 90 per cent of all persons at some time are infected with tuberculosis, only one tenth of these die of the disease. In fact, most infected persons never know they have contracted it. Obviously Nature has immunized them successfully after the disease has attacked them.

Doctor Fornet sought the secret of this immunization. He concluded after considerable research that the destructive objects called tubercles actually were the disease germs wrapped in a thick resisting layer of fat.

With ether vapor and specially devised apparatus, he succeeded in exposing the naked germ. With this he was able to get reactions and obtain a diagnosis in the early stages of the disease, whereas in most cases the victims are necessarily ignorant of their condition, simply because the fat-incased germs do not respond to early diagnosis tests.

Now that he has naked germs to work with, Doctor Fornet says he can obtain reactions to various tests more easily and decisively.

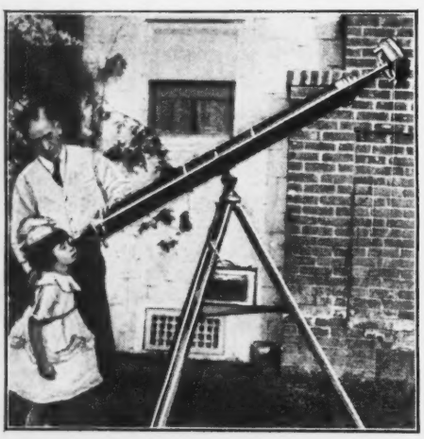
Sunflower Plant Saved by Hairpin Surgery

BY PLANT surgery of a remarkable sort, accomplished with a little raw egg and a hairpin, Mrs. Zaida Edwards, of Omaha, Neb., has succeeded in transforming a stunted, dying sunflower plant into a healthy giant—one of the largest plants of its kind on record in the United States.

Mrs. Edwards and her giant sunflower

The story begins when it was only two feet tall, and barely living. A worm, snugly ensconced in a large hole near its top, was sapping its life. A deft hairpin dispossessed the worm and cleaned the wound. Then the surgeon noticed that flies and ants were investigating the cavity. So she filled it with a little raw egg.

Within less than 24 hours, she declares, the plant had grown two feet and its wound had healed. With astonishing rapidity, it continued to ascend. Today it stands nine feet high and its flower measures seven inches across.



Powerful Microscope Is Five Feet Long

WHAT is said to be one of the world's largest microscopes—five feet long—has been completed by W. H. Reagan, of Los Angeles, Calif., who spent more than a year in calculating and perfecting its intricate design. Its powerful eye is claimed to reveal amazing detail in the minutest objects.

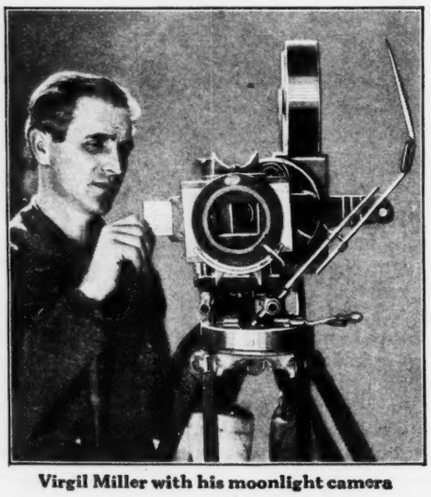
Synthetic Wood Alcohol

WOOD alcohol, of which the United States produces 17,000,000 gallons a year, requiring the consumption of more than 2,000,000 cords of hard wood, can be made from natural gas, chlorine, and lime.

"Moonlight Movies" Filmed in the Daytime

A PERFECT illusion of moonlight is claimed for "night" movie films taken in the daytime through a light filter just invented by Virgil Miller, a camera man at Universal City, Calif. Three pieces of glass in this contrivance are said to filter from light entering the lens all but the rays that are found in moonlight.

Strange effects result from its action. Red, which ordinarily photographs as black, appears white. Blue, which is white on the usual film, tends to black. A blue sky becomes black.



Virgil Miller with his moonlight camera

BUTTER and butter substitutes are easily distinguished by a simple test. Hold a spoonful over the teakettle spout or at some distance above a gas flame. If the contents become a sort of foam, you have butter. Substitutes melt.

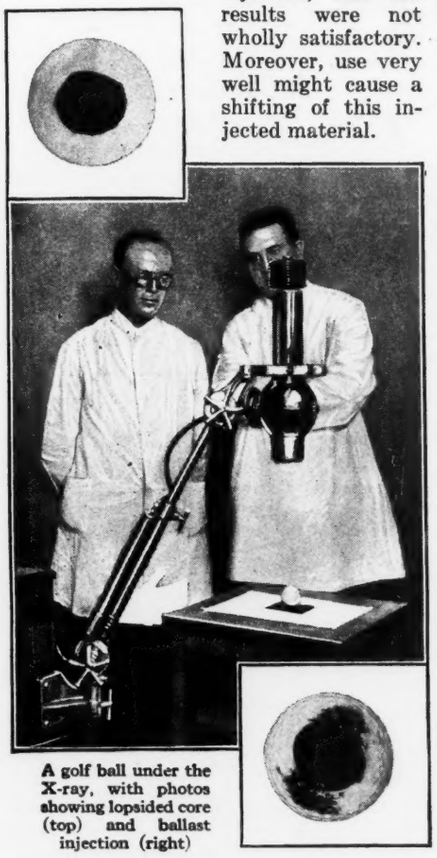
Dubbed Golf Shots Laid to Imperfect Balls

CONVINCED that many a disastrous golf stroke, often one crucial in a championship tournament, should be held against the ball and not the golfer, Dr. B. L. Taylor, a Washington, D. C., dentist, attacked 10 of the best-known brands with a vise, a mercury bath, and his dental X-ray.

Only one ball of the 10 was found by the X-ray to have a perfect, round core, he reported. Yet a ball with an irregular core will not travel true to line. As soon as its velocity diminishes, it will tend to roll toward the side with the most weight.

The same ball was the only one of the 10 to pass the mercury test successfully—the only one that did not turn over or shift to accommodate uneven weight, when floated in the liquid metal.

Remedial balance was attempted in several of the balls by a hypodermic injection, but the results were not wholly satisfactory. Moreover, use very well might cause a shifting of this injected material.



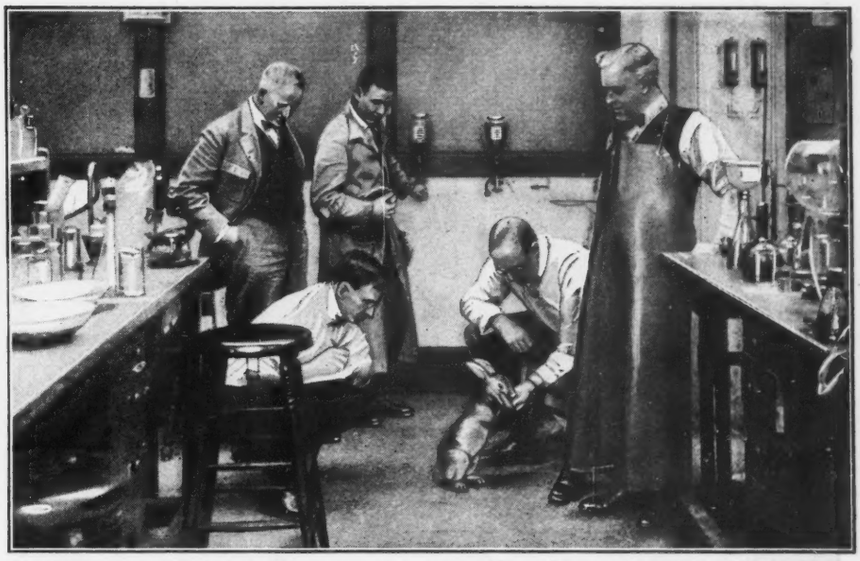
A golf ball under the X-ray, with photos showing lopsided core (top) and ballast injection (right)

Using the jaws of a vise as a caliper gage to determine exterior roundness, Doctor Taylor found again that only the one ball of the 10 was perfect. Evidently failure to achieve roundness of core had doomed the remaining balls to surface irregularity, in spite of all remedial measures.

The purpose of these researches is to establish a standardized ball for golf tournaments.

The Tungsten Filament

TUNGSTEN filaments used in electric-light bulbs and vacuum tubes are coils of almost invisible wire only one thousandth of an inch thick, wound on a core of steel or brass only four one-thousandths of an inch through.



Feeding coffee to a rabbit in laboratory tests at the Massachusetts Institute of Technology

Coffee Not Injurious, Investigators Find

COFFEE has been tried and acquitted by the Massachusetts Institute of Technology, under the direction of Prof. Samuel C. Prescott, of the Department of Biology and Public Health. The verdict undoubtedly will be a popular one, for Americans use nearly 14 pounds of coffee annually per capita—or a total of 1,398,176,000 pounds.

The investigators, in a comprehensive laboratory research, subjected the chemistry, microscopic structure, and micro-organisms of coffee to painstaking analysis. Finally, coffee was fed to rabbits to discover the effect upon living creatures.

Following are the conclusions to which these experiments led the investigators:

Coffee has a remarkably stimulating and fatigue-relieving effect, mildly increasing heart action and one's ability to work, and aiding concentration. Unlike other stimulants, it produces no subsequent depression and does not draw upon the body's physical reserves.

Your Body Is Losing Weight Every Second

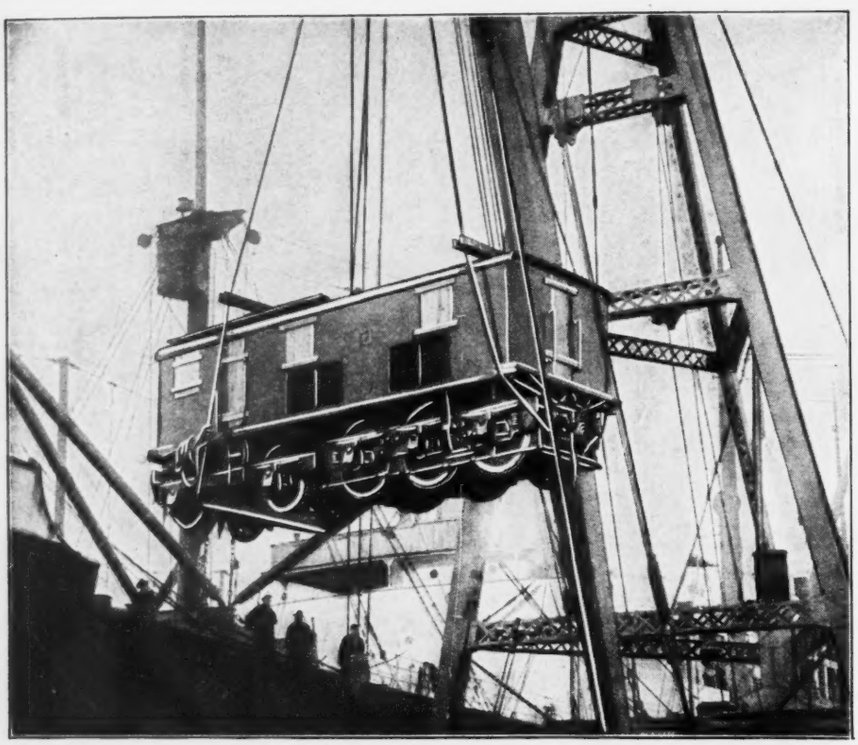
FIVE minutes from now, unless you eat or drink in the meantime, you will weigh less. In fact, you will weigh less a minute from now, because the body constantly is losing weight by evaporation and by loss of carbon. This carbon is obtained from your food and is lost by breathing, which combines the food with oxygen, forming carbon dioxid.

Powerful but exceedingly delicate scales, devised recently by the Carnegie Institution, are now being used to measure the sum of these losses. In one of the tests a man seated on the chair of the scales lost so rapidly that small weights had to be added steadily to keep the balance even. Most of this loss is by perspiration, which usually is not noticed, except on hot or humid days or after unusual physical exertion. The stouter one is, the more weight is lost by perspiration.

Numerous interesting facts have been revealed by the new scales. The more clothing a person wears, the more rapidly does he lose weight, because of increased perspiration. A football player lost 14 pounds in a game lasting 70 minutes. A marathon runner lost 8½ pounds in a three-hour race. A varsity oarsman lost 5½ pounds in a four-mile race lasting 22 minutes. In such extreme exertions, of course, a small part of the loss consists of burned tissue. The remaining loss is through breathing and perspiration.

The scales also are finding invaluable use in hospitals as a means of measuring the activity of a patient's bodily processes.

Measuring the body's loss of weight



Electric Speed Giant Shipped to France

THE world's fastest electric locomotive, which won its title with a 105-mile speed in recent tests at Erie, Pa., has forsaken its native land. It was loaded on a freighter recently, consigned to the Paris-Orléans Railroad, in France, which is electrifying 150 miles of its lines.

The picture shows the locomotive in midair, as it was being slung aboard the vessel.

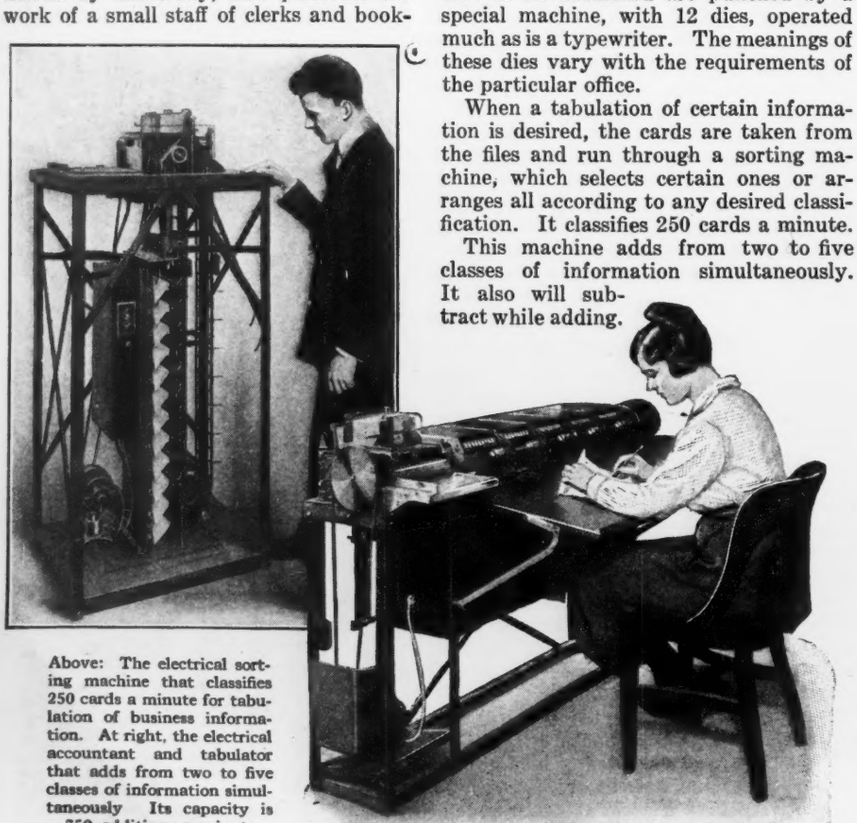
Machine Performs the Work of Many Clerks

A MECHANICAL accountant and tabulator of amazing versatility driven by electricity, now performs the work of a small staff of clerks and bookkeepers in a number of Eastern offices.

Cards printed according to the information to be tabulated are punched by a special machine, with 12 dies, operated much as is a typewriter. The meanings of these dies vary with the requirements of the particular office.

When a tabulation of certain information is desired, the cards are taken from the files and run through a sorting machine, which selects certain ones or arranges all according to any desired classification. It classifies 250 cards a minute.

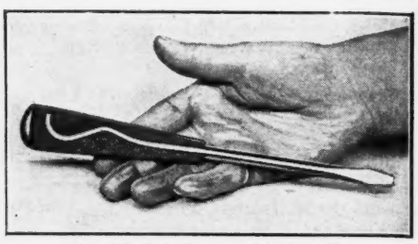
This machine adds from two to five classes of information simultaneously. It also will subtract while adding.



Above: The electrical sorting machine that classifies 250 cards a minute for tabulation of business information. At right, the electrical accountant and tabulator that adds from two to five classes of information simultaneously Its capacity is 750 additions a minute

New Twistless Blade for Insulated Screwdriver

MANY insulated screwdrivers develop a twisting blade after a few months of use. To obviate this, the inventor of a new type of tool has bent the shank of the



How blade is fastened in handle

blade inside the handle to an irregular shape, with the idea of distributing the strain of twisting on the handle when it is turned under pressure.

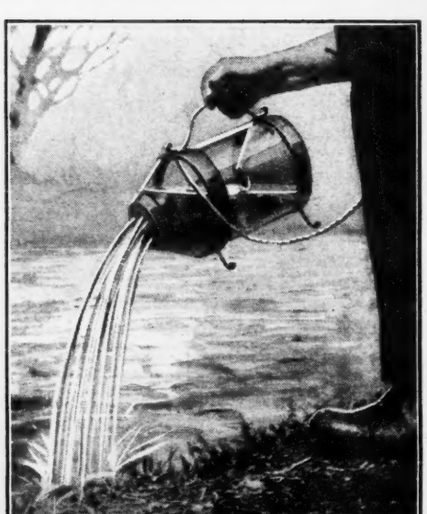
The handle of the screwdriver is of rubber.

Transparent Minnow Trap for Fishermen

A TRANSPARENT minnow trap, nearly a foot long yet weighing less than 1½ pounds, is one of the new accessories for anglers.

It is cylindrical in shape, sheeted around with a transparent material. An upstream opening narrows to a size just sufficient to admit a good-sized minnow.

Entering water flows out through a perforated galvanized iron plate at the



Pouring water from catch of minnows

funnel-shaped end of the trap. The trap stands on two pairs of wire legs and has a wire handle.

Gelatin a Valuable Food

THE food value of gelatin is far greater than is realized generally, according to the announcement of chemists of the Mellon Institute of Industrial Research, University of Pittsburgh, who recently completed a scientific investigation of the subject.

The greatest benefit is derived, they say, when gelatin is combined with other foods such as cereals, bread, milk, eggs, and ice-cream.

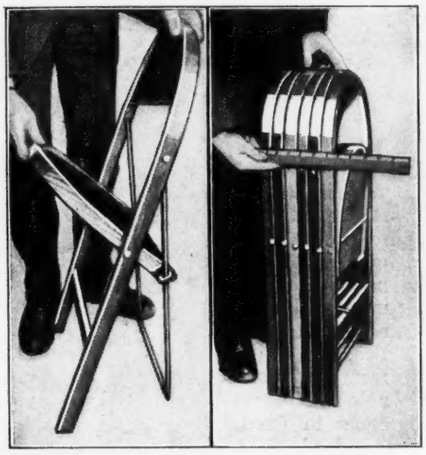
Nine Collapsible Chairs to a Foot of Space

NINE of the newest type of collapsible chairs, when folded, would make a row less than a foot long. Each chair collapses to a thickness of one and a quarter inches.

These easily portable seats are especially adapted for conventions, banquets, lectures, dances, or for camping. A number of them can be carried conveniently on a motor camping trip.

The damage done to chairs by moving them frequently is said to have been reduced materially by the invention. They can be stored handily in halls in sufficient numbers to accommodate large crowds.

Although of solid construction, the seats are said to be surprisingly comfortable for folding chairs, each having an upholstered leather seat and a back rest of comfortable design, shown in the left-hand illustration below.



Six chairs, when collapsed, make a row seven and a half inches long, as shown

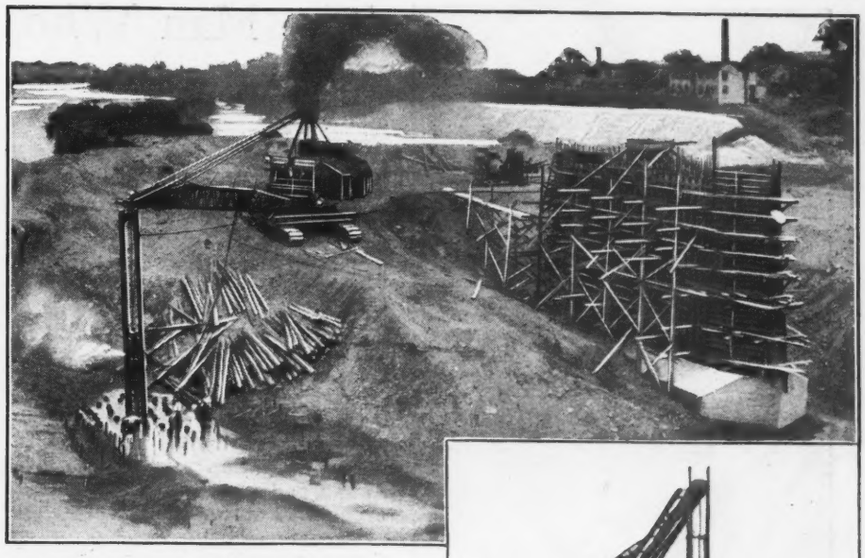
Our Bodies, like Engines, Must Be Cooled

IF IT were possible to inclose a man so that while he could breathe, no heat could escape from his body, he would die quickly.

Such is the announcement of Dr. T. H. Read, supervising mining engineer of the Department of the Interior, and F. C. Houghton of the American Society of Heating and Ventilating Engineers, who have completed an investigation of effects of heat on the body.

In a series of experiments it was found that a dry-bulb and wet-bulb temperature of 112.5° F. could be borne for only 35 minutes, even when the subject was at rest. A temperature of 100 degrees could be tolerated only 45 minutes.

"The human body, like any other internal combustion engine, must be cooled in order to function properly," says the report of the investigators. "Under ordinary circumstances the air surrounding people is enough cooler than themselves to permit the heat generated within the body to be given off without difficulty. At higher temperatures, or when the rate of work with its corresponding generation of heat is high, the body cannot throw off heat fast enough, so it begins to sweat. Evaporation of the sweat cools the body."



Steam Excavator Turned into a Pile Driver

A DRAGLINE excavator was used recently to drive piles in the construction of the Black Street bridge, at Hamilton, Ohio. As many as 52 piles were swung, spotted, and driven home, with an average penetration of 18 feet into gravel in a 10-hour shift.

The bucket was removed and the pile-driver leads hung from the end of the boom with cable lashings. Thus the dragline became virtually a caterpillar-mounted locomotive crane handling a pile-driver.

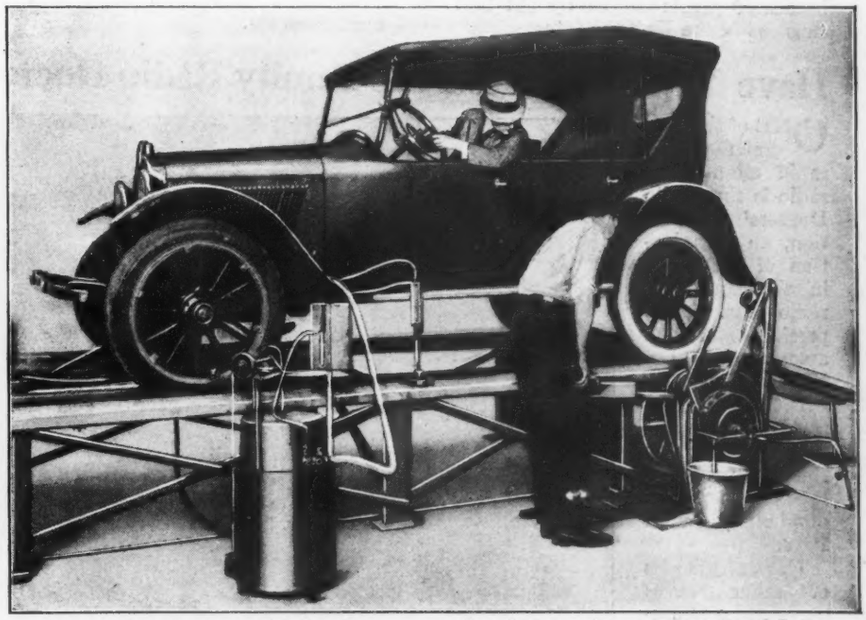
The pile-driver mechanism was attached to the hoist cable of the dragline so that it could be raised or lowered easily.

How the excavator was used to drive piles in building a bridge

Testing-Stand Diagnoses Automobile Ills

A DIAGNOSTIC testing-stand that detects and measures virtually all engine troubles in motor cars now is used in a number of Eastern garages.

It consists of a chassis-testing dynamometer that measures the brake horsepower delivered to the rear wheels: a gasometer to determine the amount of leakage past the pistons; a flowmeter to measure gasoline consumption; a special gage to measure compression pressure while the engine is running; and a spray valve, condensing plate, and still to find speed of oil passing to combustion chambers.



A car undergoing tests, showing instruments that detect and measure engine defects

Powerful Receiver Carried on Hiker's Belt

EQUIPPED with this radio belt, the hiker can carry with him, through the woods and over hills, or in a camp, the voices of noted men, the symphonies of famous orchestras, and the story of the day's events.

The apparatus, devised by Henry Farkouh, of New York City, is a powerful four-tube receiver, the parts of which are mounted on a narrow, shelflike baseboard fastened about the waist.

The set is said to have sufficient sensitivity to operate a loudspeaker. It is claimed that broadcasting stations a thousand miles away can be heard with it.

RADIO dances have become one of the most popular forms of entertainment in the Yukon during the past winter. Residents of Dawson and many a small settlement along the Yukon River are reported to have tripped the light fantastic to broadcast music played by the best orchestras in the United States.

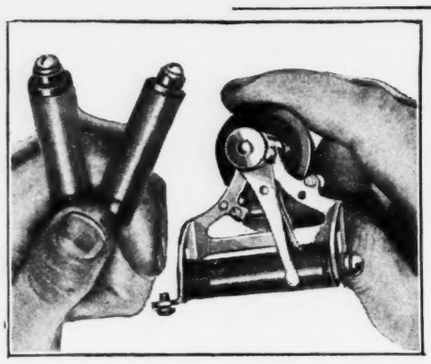
The Man Who Sends Time Signals

YOU—wherever you live in the United States—have heard him many a time over your radio set. He is Paul Sollenburger, of the United States Naval Observatory, at Arlington, Va., the man who sends out the twice daily time signals —at noon and at 10 P.M.

The sending apparatus of the Naval Observatory is one of the most powerful in the world. Frequently it is in touch with Cordova, Alaska, and sometimes even with Europe.

Many broadcast stations retransmit Sollenburger's signals on wave lengths within the range of the average receiver. Yet, because of the speed of radio waves, you hear the signals almost simultaneously with their transmission from Arlington.

Paul Sollenburger, time signal operator at the Arlington station



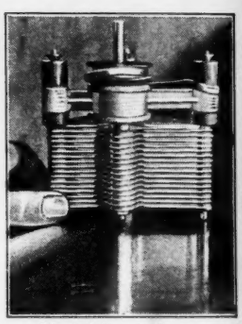
A Changeable Rheostat

A NEW rheostat to fill the need for easy change from one resistance to another has been devised for fans who like to use dry-cell and storage-battery tubes interchangeably. All that is necessary is to replace the resistance cartridge with another one of the required value.

Three standard cartridges of eight, 25, and 40 ohms are available to suit the requirements of various tubes and tube arrangements.

New Variable Condenser for Finest Tuning

IN TUNING a radio receiver for the best results, it is desirable to have a variable condenser of the lowest possible maximum capacity, in order to afford a finer degree of variation between maximum and minimum capacities. Yet the fact that variable condensers come in fixed, standard sizes, makes fine reductions in capacity range impossible.



Variable condenser

To overcome this difficulty, a new type of condenser is so constructed that any number of plates can be removed to lower the capacity range. The instrument finds its best use in experimental circuits, where the receiver must be adapted to widely varying conditions.

Have You Consulted the Family Radio Doctor?

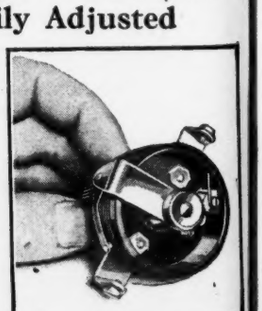
ONE of the outgrowths of the rapid advance of radio is the Radio Doctors' Association, an organization of specialists in the curing of radio ills. The president of the association is Dr. H. S. Lewis, F.R.C., builder of the first set capable of receiving the Government long-distance radiophone tests in 1912.

These physicians of ether waves serve radio manufacturers and fans.

Dr. H. S. Lewis, president of the Radio Doctors' Association

Novel Type of Rheostat Is Easily Adjusted

AN IMPROVED form of Vernier rheostat in which the contact arm can be adjusted to any point of the resistance wire recently has been perfected by a manufacturer of radio devices.



Adjusting the rheostat

The resistance wire is fitted in a helical groove on the cylindrical drum.

An unusual feature is the fact that the wire can be removed easily and another wire of a different resistance wound in its place. An adjustment takes up any slack.

The home we chose—a sturdy Dutch colonial house of six large rooms, sleeping porch and bath. Floor plans are shown below

Adventures in Home Ownership

Chapter I—We Hunt a Ready-Built House

By Phil M. Riley

Noted American Authority on Architecture and Building

TO MOST of us the fun of hunting a house we can call our own is like the fun of going fishing, of sitting by an open campfire, or of hiking through unfamiliar country—it seems to be born in our flesh. In my time I must have explored at least a thousand houses from garret to cellar. I have made the personal acquaintance of well-set-up houses, shoddy houses, slovenly houses; houses whose four walls have held a lifetime of happiness and comfort; other houses that, like unfaithful friends, promised only disappointment and regret.

Yet even now the opportunity to "hunt a house"—to open new front doors and find the surprises that lie within—brings the same old instinctive thrill of discovery.

So it was when I heard the voice of Marion Hunter on the telephone.

"Believe it or not," she was saying, "Jim and I are in your town to get us a home of our own. We figure we've been long enough paying out hard-earned cash to landlords. Could you spare us enough time to guide us away from the pitfalls?"

Could I? If Marion Hunter was still the same Marion who used to lead us kids over treacherous floor beams, planking, and rafters in the old days, this was to be a merry house hunt.

"Come on, you prodigals!" I almost shouted. "I'll be waiting for you here with the car."

From the occasional news I had received, I surmised that they wanted a cottage or bungalow of six or seven rooms, sufficient for them and their two small children.

I found my guess was correct when Jim and Marion burst in upon me unceremoniously on a tide of bubbling excitement.

"Look here!" cried Marion almost before we could exchange greetings. She was holding high a much crumpled sheet of paper. "I have a whole list of them, all the way from $7500 up. Pay your money and take your choice."

"Fine!" I replied. "That's forethought. Let's go."

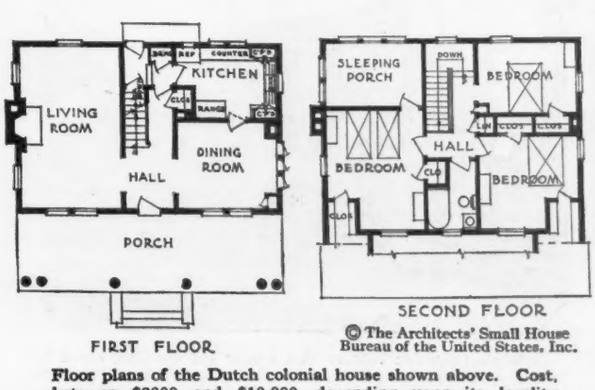
We picked the nearest house on the list and soon were on our way.

"Ooo! Look! Isn't it a little beauty?" Marion exclaimed as the car stopped before a newly built cottage of New England colonial design.

"It sure is," echoed Jim. There was a pleased, boyish gleam in his eyes.

And it surely was. The whole exterior design of the house, with its clean white siding, its green shutters and green shingled roof, seemed to be arranged to invite the home seeker. It was set upon a roomy lot, about 75 feet wide and 150 feet deep, in a newly developed and restricted residential section of the town, about 10 minutes' walk from a railway station. The street was paved. Cement sidewalks were in. A cement driveway led to a neat little one-car garage in the rear. Small shade trees and shrubbery had been planted. The setting seemed to be ideal.

But the pleasure of this first impression was eclipsed as we opened the front door and stepped into a small hall that led into a spacious living-room



© The Architects' Small House Bureau of the United States, Inc.

Floor plans of the Dutch colonial house shown above. Cost, between $8000 and $10,000, depending upon its locality

extending the entire width of the house. On one side of the room two French doors opened to a large living porch. On the other side was a fireplace with a Colonial mantel.

Marion stood in the center of the room, speechless with delight.

"Oh, it's lovely," she gasped; "just what I've always wished for, fireplace and everything." She was like a little girl playing with her first doll-house. "Look! The piano will just fit here, and the bookcase here"—skipping from one end of the room to the other—"and the grandfather chair here, and—"

She was visioning exactly how the room would look, dressed in its furnishings, while Jim stood by, smiling his pleasure, yet seeing little beyond the white plastered walls that he was scanning methodically.

"A breakfast nook!" Marion was dancing again. "I never dreamed we could have one! And a dear little entry with a door where the iceman can put the ice right into the box without even coming in!"

It was the sort of kitchen to gladden any housewife's heart. But what caught my eye was the arrangement of the cupboards that formed a great long built-in cabinet extending clear up to the ceiling. Each cupboard was fitted with glass doors. Beneath was a rather small enameled metal sink, bordered on each side by wooden drainboards extending in a counter effect the full length of the cabinet. Beneath the sink and boards was a series of low cupboards for pots and pans. The entire arrangement resembled the old-time butler's pantry, even to the tall spindling arched faucets. What the builder's purpose could have been, I cannot say, unless it was to catch the eye of the uninitiated. Marion, however, was not one to be so enticed.

"This will never do!" was her comment. "Wooden drains, dark cupboards—bugs, mice, dirt." She shook her head sadly. "You just can't keep them fresh and clean. Why didn't that builder have sense enough just to put in a nice porcelain sink and forget about the other fixings? Maybe we can get him to do it for us."

We opened a door that gave entry from the kitchen to the cellar stairs. That cellar! Stagnant water from the last rain lay in small pools on the uneven cement floor. The cement walls were dark and spotted with moisture. The window sashes, too, were water logged.

"Not much of a place for a workbench or a laundry, I should say," Jim remarked.

"Yes, and you'd have to do the bailing act every time it rained," I added. "Look here."

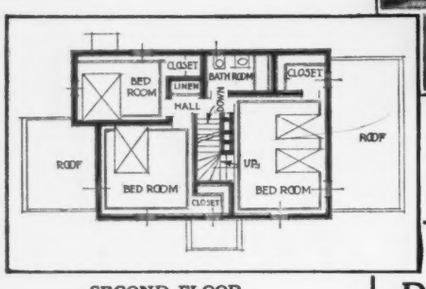
I opened one of the windows and we looked out into the yard. Not only was the grading higher than the base of the windows, but it sloped gently *toward* the house. It was easy to see what happened every time there was a rain. The cellar became a veritable reservoir. And to make matters worse, there was no floor drain. The flood was heightened, too, by the fact that there were neither gutters nor leaders to carry away the rain that poured from the roof.

"I'm afraid you'll have to be prepared for the worst," I warned. "I have seen many a cellar like this. In some cases the trouble has been remedied by regrading the whole yard, an expensive job. But here the damage goes further than that. If you examine closely, you'll find that the continual attack of water has caused the foundations to settle and crack. And this leads us back to the crack that Jim saw up in the living-room plaster—the one Marion wanted to putty. Did you notice that there were similar wide cracks in the dining-room and kitchen?"

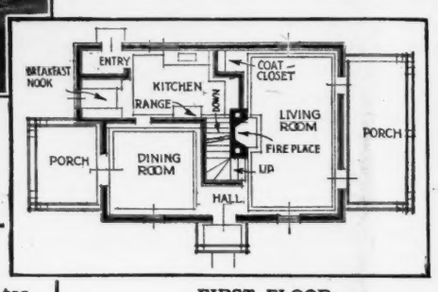
"But what have they to do with the cellar?" Jim inquired.

(*Continued on page 143*)

An unusually attractive home of New England colonial design, with six rooms and bath. This house we passed up simply because of its evident slovenly workmanship and poor materials



SECOND FLOOR



FIRST FLOOR

A Handbook on Home Buying

BY ARRANGEMENT with the United States Department of Commerce, POPULAR SCIENCE MONTHLY is able to offer to its readers copies of the government booklet, "How to Buy a Home," recently published under the supervision of Secretary Herbert Hoover.

This unusually comprehensive handbook, prepared after years of research by John M. Gries and James S. Taylor, of the Division of Building and Housing, U. S. Bureau of Standards, answers the many questions that are likely to confront the prospective home owner, and explains important safeguards in buying.

Copies of "How to Buy a Home" will be sent by the editor to our readers on request.

"You've got the right idea, Marion," I told her, trying not to appear professional. "If every woman would think about the furniture and where she was going to put it, before buying a house, it would save a lot of grief later on."

Marion, absorbed in a survey of the fireplace, continued:

"Won't it be great, Jim, those cold winter evenings—"

"You see," interrupted Jim with a sly wink at me, "we've already bought this house—with the emphasis on the *we*. What I was interested in, though, was that big diagonal crack in the plaster above the door into the hall."

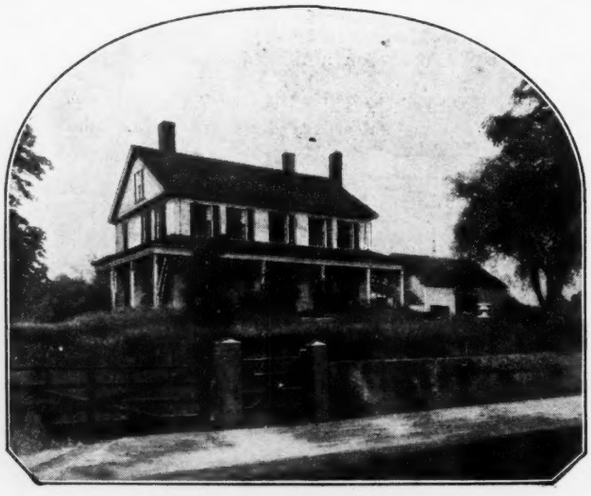
"Oh, is that all?" Marion exclaimed, with a sigh of relief. "Why, we can easily fix a crack like that with putty."

It evidently was time to assert myself as official adviser.

"Not so fast, young lady," I said. "You haven't begun yet to look at this house. Maybe we can fix that crack with putty. Maybe not. Some cracks are just cracks, you know. And others— well, they're holes that sometimes make all the difference between the house you don't want and one you do want.

"But," I added quickly as I saw a momentary look of apprehension on her face, "we'll find out all about that later. Let's move on and see the rest."

She soon forgot her fears as we crossed the hall into the cozy square dining-room with its built-in sideboard and china closet, its wide windows, and a door that gave access to another and smaller porch. Then on to the cheery white kitchen.



With extensive repairs this roomy old dwelling could be transformed into a light, airy and beautiful home. Yet the cost of improvements would eat up the price advantage

How To Find the Combination for Tuning Your Radio Set

By Jack Binns

America's Most Popular Writer on Radio

HOW can I get the best out of my receiver?

Every owner of a radio set asks himself that question, irrespective of the type of set he has, factory built or home constructed. To answer it, we must acknowledge first of all that all radio receivers come within the scope of two main classifications—those that use regeneration, and those that suppress it. Next, we must determine which of these two classes applies to our own particular receiver. Then it will be an easy task to follow the cardinal points of tuning, which are:

Rules of Tuning

1. Remember always that the tuning dials of your receiver are like the sensitive combination dial of a safe or bank vault. They require precise, careful manipulation. For every broadcasting station you wish to tune in there is a definite combination that will give the best results. It is an excellent plan, every time you bring in a new station, to keep a permanent record of the tuning combination that opened in to your reception. A suggestion for such a record appears on the following page.

2. Do not force your set—there is a limit beyond which it cannot go.

3. Do not let your set squeal, or you will waste precious energy and annoy your neighbors.

4. Do not twist the dials rapidly. They should be moved very slowly and very carefully.

5. In regenerative sets begin tuning for the station with regeneration at zero, and when the station is heard, increase regeneration until the signal is at its loudest.

6. Never increase the filament voltage of a tube above the value recommended by the manufacturer. Keep it below that point if possible. It is a matter of economy as well as efficiency. If in doubt, use a voltmeter across the terminals of the tube socket.

Operating the Regenerative Receiver

With these points in mind let us consider the correct method of tuning a regenerative receiver. Whether the set is a single, double, or triple circuit type, the main principles will be the same.

The first thing to do, of course, is to turn on the filament rheostat. If you have a small voltmeter handy, connect it across the two filament terminals, and turn the rheostat until the needle registers five volts, then leave the rheostat at that setting. On dry-cell tubes the reading should be in accordance with the rating of the tube.

In single-circuit sets the regeneration is controlled by a coupling or tickler coil. Place this coil so that the coupling between it and the aerial coil is at about 90 degrees. Now make the condenser and switch adjustments of the aerial circuit very slowly until the voices or music from the broadcasting station are heard. A little careful movement of the controlling dial of the condenser soon will show what position gives the loudest signals.

The tuning dials of your radio receiver are like the sensitive combination dial of a safe. They require careful, precise manipulation. For every broadcasting station you wish to hear there is a definite combination that will open the door of your set to the most satisfactory results in radio reception. Don't be simply a dial twister

As soon as this adjustment has been completed, the regenerative coil can be brought into closer coupling with the aerial coil, but this movement also should be made very slowly and carefully. The signals will increase in volume rapidly until they reach a point where the set "spills over" and goes into oscillation. Come back immediately to the position just preceding that, because it is in this position that your set is in its most efficient condition. If the signal strength does not increase as the coupling is tightened, reverse the leads to the tickler or rotor coil.

There seems to be a general opinion that double-circuit regenerative receivers do not radiate and cause interference with other receiving sets in the neighborhood. This is untrue. Double- and triple-circuit regenerative sets can be equally as annoying as the single-circuit type.

In tuning such circuits, it is best to keep the coupling between the primary and secondary coils as loose as possible until the station desired is heard. After that the coupling can be increased gradually, but in this case, of course, readjustments will be necessary in other parts of the set in order to clear up the signals.

The Squeal Maker

Perhaps the greatest trouble from radiating sets is caused by the inherent desire of the operator to get a little finer adjustment from his set. He is never satisfied, but must continue to fuss with the controls. This is an extremely bad habit, because it invariably causes the terrific squeals heard in other receiving sets in the neighborhood. It spoils the enjoyment not only of neighbors, but also of the fan who is forever tinkering with his dials. As soon as you have a good adjustment with the desired broadcasting station, leave your set alone. Then it will give you maximum efficiency.

Should you hear any sign of a whistle or other noise in your set, and you are reasonably convinced it is not coming from the transmitting station, reduce your filament current by making a slight adjustment on the rheostat controlling the detector tube. If this does not remove the trouble, then adjust the regenerative coil. The reason for this is a very important one:

When the Set Is Too Sensitive

Putting your set into a too sensitive condition causes the set to howl and whistle at the slightest provocation. When your set whistles, you are using up too much energy from the storage or dry cell battery to light the filaments, or are using too tight coupling between tickler and tuning coil.

For the single-circuit receiver there is always one best combination of dial settings for every transmitter. That combination will be found by tuning the aerial circuit first before touching the regeneration.

Consider now the tuning of receivers where regeneration is deliberately suppressed—the neutrodyne, the superdyne, and transformer-coupled radio-frequency amplifiers. All utilize the principle of amplifying the carrier wave of the broadcast stations before detection is accomplished. In the neutrodyne this is accomplished by opposing two capacities against each other; in the superdyne by opposing two magnetic fields, and in the transformer-coupled radio frequency by introducing resistance in the circuit.

In tuning the neutrodyne, the three controlling dials always must be set at the same points for any particular station. An important point to remember, however, is that under no circumstances should the filament current be too high. Otherwise the neutralizing balance of the set may be upset, producing regenerative squeals. High filament current is unnecessary, spoils reception, and is costly.

Tuning the Superdyne

The best way to tune the superdyne is to place the negative feedback coil at maximum coupling so that there is complete neutralization, then tune the aerial and plate condensers slowly and carefully until signals are heard. If this rule is followed, the set never will squeal, and the best possible results will be obtained. Here, too, the filament current should be kept as low as possible consistent with good reception results.

In transformer - coupled radio-frequency amplifying sets, regeneration is controlled by a potentiometer placed across the filament battery. This is so connected into the circuit that it controls the grids of each of the radio-frequency tubes, and is said to control the amount of positive or negative bias on the grids. The potentiometer also dampens out any possible regeneration by adding resistance to the grid circuits.

Since resistance causes losses in any receiver, we are really using one evil in this case to overcome another that happens to be slightly worse. The problem, then, in radio-frequency amplifiers using fixed transformers is to keep the resistance as low as possible, while preventing regeneration in the amplifier. The best way to do this is to keep the filament current as low as possible. Thus we can reduce the amount of resistance actually being used in the grid circuits, and thus approach a closer negative bias on the grids without the set going into oscillation.

Losses Caused by Shielding

Amateurs long have called the potentiometer a "losser." This is a very apt phrase because it expresses the actual function of the instrument.

While on the subject of losses it would be well to point out to fans who make their own sets that shielding should be avoided as much as possible. This adds losses to a set. Never put a condenser inside a coil, no matter how much space you desire to save. In aerial circuits it is always best to have the aerial condenser in series with the aerial tuning-coil. The movable (or rotor) plates of the condenser should be joined with the aerial, and the stationary plates of the condenser with the coil. The use of a shield then is unnecessary.

Where a double circuit is used with a condenser across the secondary coil, the stationary plates of the condenser should be connected with the grid side of the coil, and the rotor plates with the filament side. No shield then will be necessary to protect the set against body capacity.

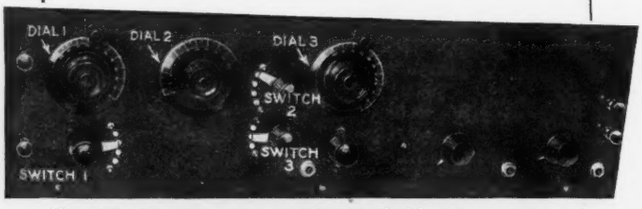
We now come to a consideration of the detector tube—which after all is the most sensitive element in a receiving set. The use of modern hard tubes has eliminated much of the extra sensitivity and allows for more stable operation, since these tubes are not at all critical to filament current and plate voltage. It is imperative, however, that not more than 45 volts be placed on the plate of a detector tube. Experimentation soon will determine which is the best voltage to use there.

A well-constructed mica variable condenser can be employed as a grid condenser with maximum results. A variable grid leak also may be used, but great care must be exercised in choosing it. Do not take one that shows any possibility of becoming loose inside, otherwise you will be troubled with noises in your set for the rest of its life. If a compression type of leak is used, make sure there is no possibility of looseness.

A well-designed variable pencil marking is as good as anything. If such a leak is used, adjust it for the tube employed as a detector, and when the best position is found, leave it alone. The same is true for the grid condenser. Remember that when a grid leak is used—whether it is of the fixed or variable variety—the return lead of the detector tube grid circuit must terminate at the positive side of the A battery.

There are many little details in the audio-frequency side of a receiver that materially affect the efficiency of a set. No matter how perfectly the radio-frequency and detector side of the circuit may be constructed, efficiency will be completely destroyed if the audio amplifier is not constructed correctly. Moreover, serious distortion will be experienced.

1. Call letter	WDAP
2. Location	CHICAGO, ILL.
3. Owner of Station	CHI. BD. OF TRADE
4. Distance	700
5. Wave length	360
6. Kilocycles	830
7. Power of station (in watts)	1000
8. Date received	1/29/24
9. Hour received	11. P.M.
10. Circuit Used	REG. ONE-TUBE
11. On what stage received	DETECTOR
12. Phones or loudspeaker	LOUDSPEAKER
13. Good, fair or poor	FAIR
14. Settings	
Dial 1	60
Dial 2	47
Dial 3	82
Switch 1	SWITCH PT. 1
Switch 2	SWITCH PT. 2
Switch 3	SWITCH PT. 1
Remarks	RATHER CRITICAL



The table above suggests a useful method of keeping a permanent tuning record of each broadcasting station you bring in. By dividing paper into lined columns, one column for each station, and jotting down notes opposite the numbered headings, as indicated, you will have an invaluable chart of tuning combinations for reference

Use of the C Battery

With the new type of low-consumption filaments in all modern tubes, it is imperative that a C battery be used on the audio amplifiers, where more than 45 volts are put on the plates of the tubes. Do not forget, however, that if you can obtain sufficient volume with 45 volts, it is extreme folly to increase the voltage. The reason is that, in accordance with Ohm's law, the current drain from the B batteries will be increased the moment we add more voltage, and consequently their life will be shortened.

Naturally there are many cases where sufficient volume cannot be obtained to work a loudspeaker satisfactorily below 90 volts. In such cases a C battery is absolutely necessary, and it should be at least 4½ volts in value.

In the audio-frequency side of a receiver, the rheostat always should be placed in the negative side of the filament, and the connection from the secondary of the audio transformer should be joined to the negative filament lead at some point between the battery and the rheostat.

One Battery for Both Stages

A C battery, when used, should be put in at this point. In other words, the positive side of the C battery should be joined with the negative lead of the filament circuit at a point between the rheostat and the A battery, and the negative lead from the C battery then should be joined with the filament side of the audio-transformer secondary. One C battery may be used for both stages of audio frequency, provided the instructions given above are fully followed.

Next month Jack Binns will tell how to select radio parts to get best results.

How to Build a Loudspeaking Three-Tube Radio Receiver

By Joseph Calcaterra

Radio Editor of POPULAR SCIENCE MONTHLY

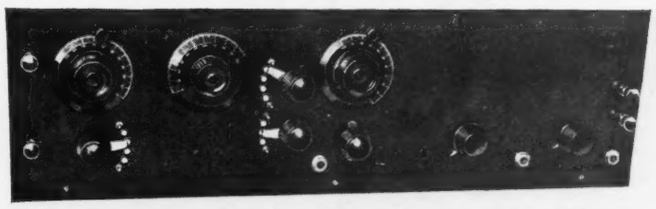


Fig. 1. Front view of the three-tube receiver, showing panel layout

WHAT is the ideal three-tube receiver for home construction? This question has called forth volumes of letters from radio fans who like to build their own sets and to experiment with various types of instruments.

It is generally conceded that a receiver, to be efficient, must be a good distance-getter, simple to operate, with loudspeaker volume on distant stations. It must be so simple to construct that it will not require weeks or even months of time to put it on an operating basis.

The Ideal Circuit

In constructing a three-tube receiver there is at least one type of circuit that, if correctly designed, meets these requirements and assures satisfaction. It is the Armstrong three-circuit hook-up—a circuit that has stood the test of time, and has won a reputation for ease of construction, efficiency, and simplicity of operation.

As shown in the wiring diagram at the bottom of this page, the circuit consists of inductively coupled primary and secondary circuits with tickler coil feed-back for regeneration. Vernier variable condensers of .0005 mfd. capacity usually having 23 plates, are used across primary and secondary circuits to provide for fine tuning.

Winding the Tuning Elements

The primary and secondary coils are wound on the same tube, and regeneration is provided by the rotor of the variocoupler which acts as a tickler coil.

Concentrating the tuning elements in this manner allows plenty of space for the other parts and wiring. Since all the tuning coils are close together, long, straying wiring is unnecessary to connect the detector unit, and it is in this way that interaction between circuits is eliminated.

Variation in coupling can be obtained by shifting the switch arms of switches 6 and 7 to the upper or lower portions of the secondary coil. This varies the distance from the portion of the secondary coil between the two switches to the primary coil, and consequently makes the coupling loose or close, depending on whether the upper or lower portion of the secondary coil is included between the switches.

Since the receiver is very sharp in tuning—a desirable feature in eliminating interference — some practice is required before familiarity in tuning is obtained. It is advisable, therefore, to give the receiver a thorough trial for at least a week before attempting to make any changes.

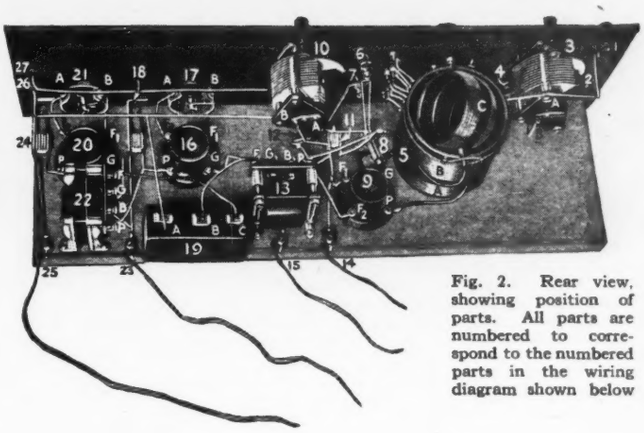
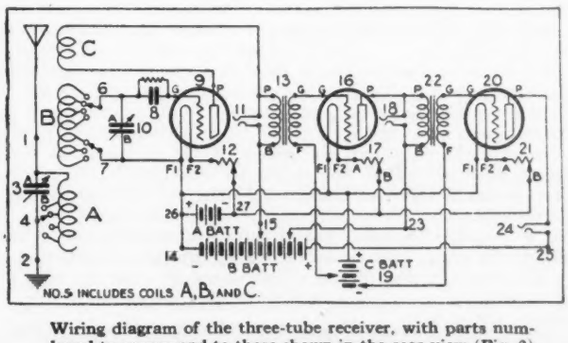


Fig. 2. Rear view, showing position of parts. All parts are numbered to correspond to the numbered parts in the wiring diagram shown below

By using a 7 by 24 inch panel it is possible to arrange the parts as shown in Fig. 2, so as to permit complete separation of grid and plate circuits. To facilitate construction and wiring, all parts in the wiring diagram have been numbered to correspond to the numbered parts shown in the rear view photograph of the receiver (Fig. 2).

Numbers 1 and 2 are the aerial and ground posts respectively. Numbers 3 and 10 are .0005-mfd. Vernier variable condensers. Most 23-plate condensers have this capacity. Since the tuning of the set is very sharp, it is absolutely necessary that the Vernier type of condenser be used.

Numbers 4, 6, and 7 are inductance or tap switches. Number 4, which is hidden from view by condenser 3, is a four-point switch and is used to vary the number of turns of the primary coil *5A*. Number 6 is a four-point switch with which the first four taps of the secondary coil are connected, and No. 7 is a three-point switch with which the last three taps of the secondary coil are connected.



Wiring diagram of the three-tube receiver, with parts numbered to correspond to those shown in the rear view (Fig. 2)

The Special Tuner

Number 5 is the special tuning unit. This unit is similar to a standard variocoupler in general appearance, but different in actual construction. The winding *A* forms the primary inductance of the tuning system; the winding *B* forms the secondary inductance, while winding *C* on the rotor serves as the tickler coil to provide regeneration.

A standard variocoupler having a stator tube from 3½ to four inches in diameter, and at least four inches long, can be rewound, or, as was done in this case, a special coupler can be made at home. The stator tube of this variocoupler was four inches in diameter and 4½ inches long. The secondary winding was started one half inch from the top end of the tube and 60 turns of No. 22 D.S.C. wire were wound on, taps being taken at every 10 turns. Counting the two ends of the winding, this made seven taps in all.

Method of Tapping Coils

The taps were taken at the right of the coupler, looking at it from the front, and were made in a straight vertical line about 1½ inches to the right of a center line dropped from the front end of the rotor shaft. This brought the taps within easy reach of the switch points of switches 6 and 7 and greatly facilitated connections of the taps with the switch points.

The beginning of the primary winding was started one quarter inch below the end of the secondary coil. Forty turns of No. 22 D.S.C. wire were used on this winding and taps were also taken at every 10 turns. The taps were made in a vertical line down the side of the variocoupler, but in this case they were made on the left-hand side so as to be close to the switch points of switch 4.

The *C* winding consists of 40 turns of the same kind of wire. It is not absolutely necessary that D.S.C. wire be used, or that the size be exactly No. 22. Single or

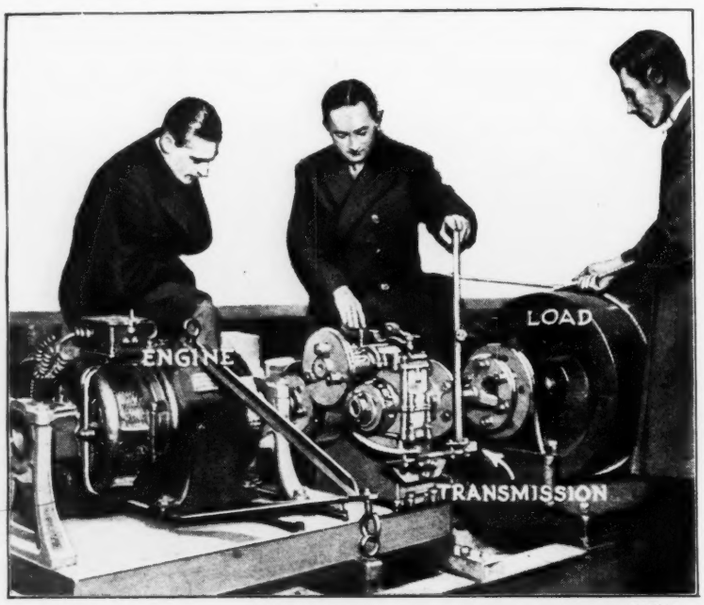
(*Continued on page 138*)

Mechanical Gearless Transmission

British Inventor Applies Pendulum Principle in New System

GEARSHIFT transmission for automobiles may be made obsolete within a few years by a revolutionary new invention that connects the engine with the driving wheels without the use of any gears whatsoever. It is the work of George Constantinesco, a distinguished British engineer.

The astonishing claims made for this invention, which is said to accomplish what automotive engineers have been attempting for years, comes with exceptional authority because of the fact that Mr. Constantinesco has achieved a brilliant record of invention, including the revolutionary timing gear that allows a machine gun to fire between the whirling blades of an airplane propeller.



George Constantinesco (center) demonstrating his new gearless transmission system with the aid of an electric motor (at left) and a brake drum (at the right). In the center is the pivot transmission mechanism, the operating principle of which is shown in the diagrams

In discarding traditional theories of speed conversion, Constantinesco claims to have eliminated the inefficient and troublesome auto gears, forward and reverse, the clutch and the rear axle drive system.

Like other automobile transmission systems, the reciprocating motion of the pistons turns a main power shaft. By means of a crank and three links, the motion of this shaft is transmitted through an oscillating flywheel directly to the final drive shaft. It is in this system of links, a crank, and an oscillating flywheel that the invention centers. It is best understood by using a cane with a large and heavy knob as an analogy.

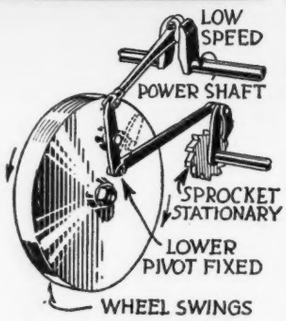
With one hand hold such a cane by the tip, the knob down, and press slightly against the side a few inches below where you are holding it. The knob will swing slowly, like the knob of a pendulum. Now press, with increasing force and frequency, on the same point. The knob will attain a certain speed of swing. After that it will swing less and less as the force and frequency of your pressings increase. But the hand holding the tip will begin to move more and more. Ultimately the knob will remain stationary and the hand holding the cane will move with strong, regular impulses.

The hand that exerts the pushes against the cane corresponds to the link from the main power shaft in the Constantinesco transmission. This link transmits power from the shaft to the oscillating flywheel, which acts precisely as would an ordinary pendulum—that is, it swings back and forth instead of turning all the way around.

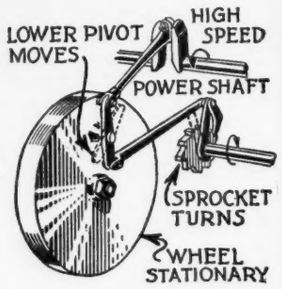
When the motor is running slowly, the impulses delivered to the flywheel correspond to the first slow pressures on the cane. The pendulum merely swings back and forth, the movement at the pivot being too slight to affect the wheels. But as the motor accelerates, the pendulum swings less and less, and the pivot, corresponding to the hand that held the cane, moves more and more. Should the speed become great enough, the pendulum would become stationary, and all the motion from the power shaft would become motion of the pivot.

The motions of the pivot are transmitted through a ratchet wheel to the shaft that drives the rear wheels. In this manner, the greater the power developed by the engine, the greater the movement of the pivot and the greater the speed transmitted by the pivot, through the ratchet, to the wheels.

Obviously, the motor can idle while the car is standing still, if it is run so slowly that the pivot moves but slightly, the power being used up by oscillations of the flywheel. Accelerating the motor diminishes these oscillations, and increases the movements of the pivot. These are transmitted to the driving shaft.



When the engine is running slowly, the flywheel swings like a pendulum, while the pivot, connected through links with the drive shaft, remains motionless



When the engine is running at high speed, the flywheel remains motionless, while the pivot moves to turn the sprocket wheel attached to the drive shaft

A single lever, the design of which has not been revealed, controls forward, reverse, and neutral. This lever merely shifts the links without disengaging any of them, and operates no gears. Thus there are no gears to be stripped, it is claimed, and greater efficiency is obtained. The mechanism for this system, the inventor asserts, will require no more space than the present gear boxes, and will weigh even less.

Since power cannot be transmitted backward through this system, cylinder compression cannot be used for braking. The inventor considers, however, that because of the efficiency of modern brakes this will be no real handicap in the operation of a car.

Know Your Car

The Pulse of Your Car—You can learn to diagnose the ills of your engine from the action of your spark plugs, just as a doctor detects your bodily ailments by feeling your pulse. Your car may have a diseased cylinder or valve. It is the spark plug that tells the tale.

Some people have an idea that if they remove and clean the spark plugs every few hundred miles, they have done all that is necessary. This is a mistaken notion. If your plug fouls, it is more important to go to the root of the trouble than simply to clean it.

See that the valves all seat properly. It may be that the valve tappet does not allow the valve to close, with the result that compression is lost and the gases in the cylinder do not burn up completely.

It is possible that the piston rings are worn or the cylinder is scored. In either case oil will come up into the combustion chamber and settle in the form of a heavy smudge over the plug points.

Leave the plugs in place until the engine indicates trouble. Then remove the cause.

Save a Fourth of Your Gasoline

How to Get Greater Power from Your Car with Less Fuel

By F. A. Platte
Department of Physics, Columbia University

RETURNING from an 1100-mile motor tour not long ago, I chanced to tell a friend that I had the gas tank filled only four times while away; in other words, that I had used about 60 gallons—approximately 18 miles to the gallon.

"Do you expect me to believe that?" he demanded. "A seven-passenger car, fully loaded, averaging 18 miles to the gallon on such a trip?"

I did not succeed in convincing him until I had shown him the notebook in which I make daily records of mileage, gas consumption, and similar data relative to my car, a little book, by the way, that saves me many dollars every year because it aids in important economies.

More than Luck

"Well, all I have to say," was his comment then, "is that you're pretty lucky."

But it wasn't luck. I can say that without boasting. The gas consumption was exceptionally small for a car of the size—possibly 25 per cent less than the average—but it was due entirely to the fact that careful adjustments and the removal of unnecessary resistances had resulted in getting maximum power out of the fuel burned.

This is a thing that you also can do by getting acquainted with your car. Getting more miles to the gallon—a goal of most motorists—is not difficult. It is merely a matter of avoiding waste in fuel, which depends on two factors—yourself and your car.

First and foremost, there is the matter of driving. It really is surprising how much fuel can be saved merely by keeping your foot off the accelerator when there is no necessity for having it there; in other words, coasting when you can. In a long day's drive coasting might save a quart or more of gasoline.

For example, on the trip that I mentioned I traveled more than two miles at 30 miles an hour along part of the Mohawk Trail in New York State with the ignition shut off and without stepping on the brake. It was a gradual slope, and the weight of the car was sufficient to keep it going as fast as the law allowed, while the compression of the motor was sufficient to prevent the car running away without my having to wear down the brake lining. At other times I coasted distances ranging between a quarter of a mile and a mile. No tremendous saving perhaps in each instance, but the total ran into valuable dollars before the trip was ended.

You can walk with less effort in well-fitting shoes than you can if your feet are incased in burlap bags. Similarly it requires less expenditure of power by your motor to propel your car on well-pumped tires than on tires that are soft.

When your tires are flat, your car is going uphill continuously. There is only one way in which the motor can obtain the necessary power to compensate for dragging tires, and that is from your gas tank. Soft tires make easier riding, but you pay for it many times over in the gasoline you waste.

If your front wheels are out of alinement, the tires will slide somewhat instead of rolling. That causes friction and consequent fuel waste, too; not a tremendous amount in a day's run, but a waste that becomes appreciable in a season's driving.

Dragging brakes are obviously prodigal of gas. Keep your brakes properly adjusted and you will effect a double saving—in gasoline and in brake linings.

Since the motor is where the fuel is consumed, it is natural that this is where it also frequently is wasted. If connecting rod bearings are too tight or not properly lubricated, added power is necessary to turn over the engine. Once again the only source from which the needed power can be drawn is your gas tank. Also, should improper lubrication be the trouble, there is the added danger of burning out the bearings.

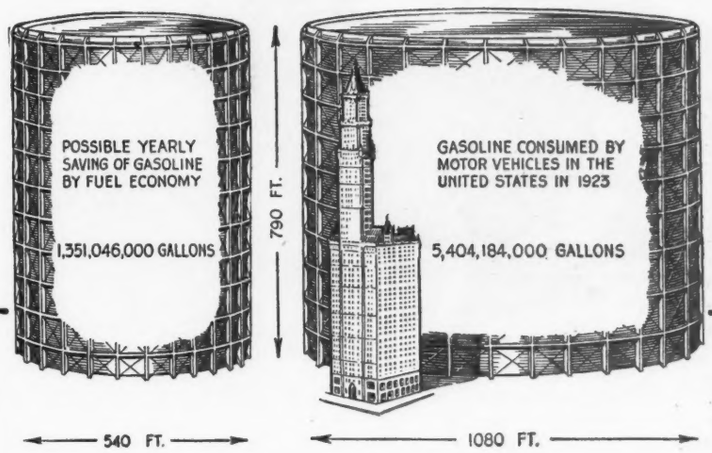
Carbon Wasteful

Carbon deposits in the cylinders cause unbelievable quantities of gas to be wasted. I was riding with a physician a few months ago, and in going up a short and not particularly steep hill it was necessary for him to shift to second in order to make the grade. I asked him why he didn't have the carbon removed from his cylinders, and he replied that he couldn't spare the car long enough to have it done.

"You'll have to have it done sooner or later," I told him, "and in the meantime every two weeks or so you're wasting enough fuel to pay for the job, besides having the inconvenience of driving a car that won't take a short hill."

Before I left him he agreed to have the carbon removed and for a few weeks to keep a careful tally of his mileage as compared with his gas consumption. It astonished him to find that his mileage increased between eight and 10 per cent after the carbon was removed.

But the most voracious devourer of


POSSIBLE YEARLY SAVING OF GASOLINE BY FUEL ECONOMY
1,351,046,000 GALLONS
790 FT.
GASOLINE CONSUMED BY MOTOR VEHICLES IN THE UNITED STATES IN 1923
5,404,184,000 GALLONS
540 FT.
1080 FT.

Last year the 14½ million motor vehicles in the United States consumed 5,404,184,000 gallons of gasoline—enough to fill a tank as high as the Woolworth Building and more than 46 times its volume.

Of this total consumption—372 gallons for each car—automotive engineers estimate that at least one fourth, or 1,351,046,000 gallons, might have been saved by economy in car operation. This wasted fuel would fill a tank of 11½ times the volume of the Woolworth Building. It represents 93 gallons consumed each year unnecessarily for every car in the country.

A number of simple methods of gasoline economy in car operation are listed below. Try them out on your car, keeping track of your gas consumption

Ten Ways to Save Your Gasoline

1. Coast whenever you can. Keep your foot off the accelerator as much as possible.
2. Keep your tires well inflated.
3. See that your brakes do not drag.
4. Be sure connecting-rod bearings are not too tight and are well lubricated.
5. Keep engine cylinders free from carbon.
6. Adjust the carburetor to a mixture in the ratio of 15 parts of air by weight to one part of gasoline.
7. Keep spark plugs clean and free from carbon to assure a strong spark for ignition.
8. Adjust the spark-plug points to .025 inch apart—about the thickness of a well-worn dime.
9. See that your battery is well charged.
10. Keep engine valves ground to seat well.

gasoline is the carburetor when incorrectly adjusted. You can have the adjustment made at any service station for a nominal fee. But the job is easy and you soon can learn to do it if you wish.

The carburetor, as every one probably knows, is where gasoline is combined with air to provide an explosive mixture of fuel for your engine. It can be adjusted to provide mixtures in infinite number. Only one mixture will be correct, though. Hence the necessity for getting the right mixture and keeping it.

The Happy Medium

When the mixture is in the ratio of 10 parts of air by weight with one part of gasoline, it is too rich. Black smoke will issue from the exhaust. The engine will labor and puff like a man out of breath. There will be little power in the motor, and most of the gasoline you are feeding to the carburetor will be going out of the exhaust.

When the ratio is 20 to 1, the mixture is too lean. Probably it will be impossible for you to get the motor to run. If you succeed in doing so, it will run very fast when idling, but will lack power to move the car and probably will stall the instant you throw in the clutch.

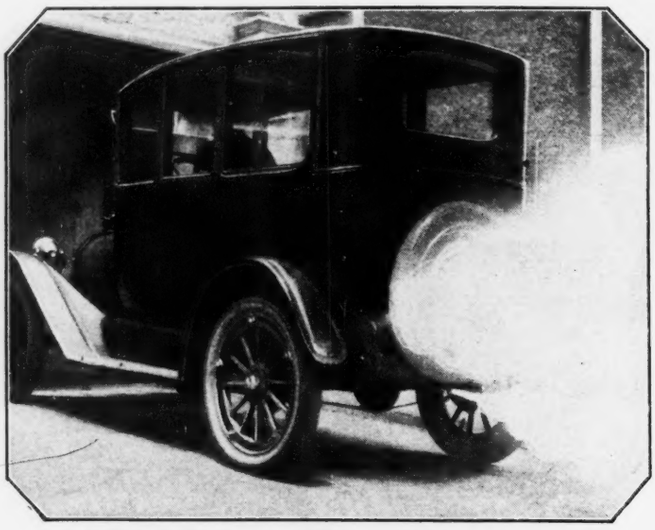
These are the two extremes of carburetor mixtures. Between them lies the proportion of air to gasoline that you must seek—15 to 1. This mixture explodes violently, and gives power and speed to the motor.

Carburetors are of so many different types that no fixed rules for adjusting them can be laid down in a few words. You must study your own carburetor, judge from the action of your motor whether the mixture is too rich or too lean, and then make your adjustments accordingly.

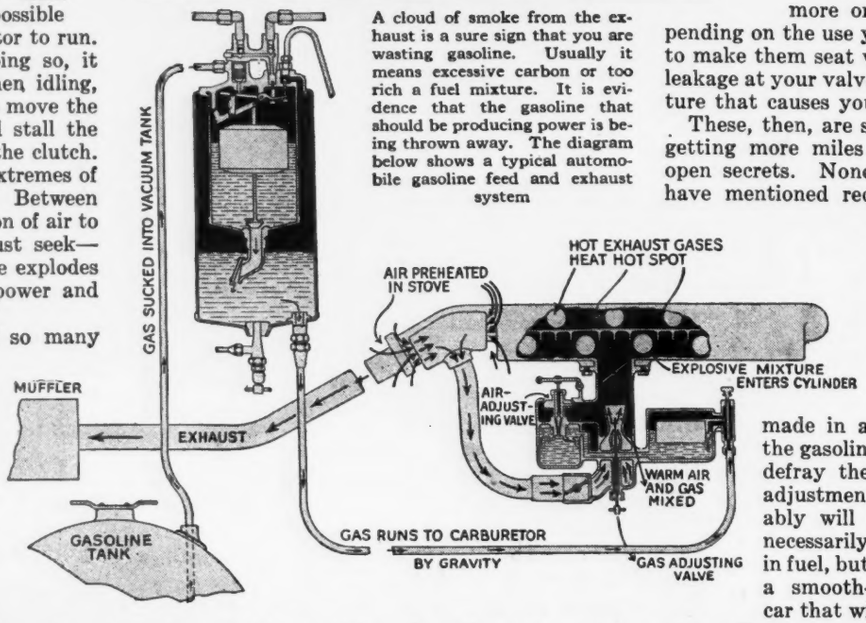
The carburetor should be adjusted for normal running conditions. Hence, the motor should be warmed up before you attempt to make an adjustment. As a first step, ascertain from the instruction book supplied by the manufacturer of your car whether the carburetor has controls both for gas and air or for gas only. If there are two controls, let your motor run with the spark retarded and close the needle valve controlling the gas supply until the motor idles smoothly. What you are seeking is the minimum gas supply that will produce a slow, quiet running of the motor, without jerkiness.

Next, advance the spark and give the adjusting screw of the air control a turn or two to tighten it. Open the throttle quickly. If dense, black smoke issues from the exhaust, the mixture is too rich. Turn the air control in the opposite way, testing by opening the throttle at every half-turn or so. Gradually the smoke will become less dense, and eventually there will be a pop at the carburetor, signifying that the mixture is too lean.

When this point is reached, start turning the air control in the opposite direction, still testing with the throttle at every half-turn, until you get the air control in a position where the motor accelerates instantly and without smoke when you open the throttle. Your carburetor is then in fair adjustment, which can be improved further by making finer tests, moving the air control nut by small fractions of turns in either direction.



A cloud of smoke from the exhaust is a sure sign that you are wasting gasoline. Usually it means excessive carbon or too rich a fuel mixture. It is evidence that the gasoline that should be producing power is being thrown away. The diagram below shows a typical automobile gasoline feed and exhaust system



Let Well Enough Alone

After this, test your car on the road. If it picks up immediately when you press the accelerator and shows power on hills, you may be satisfied that your carburetor adjustment is correct. My advice is to let it stay that way as long as the car runs well.

If your car has a fixed air valve, all changes must be made on the gasoline line. There will be a nut or screw that moves the needle valve in the nozzle. This must be turned until the correct amount of gasoline is being fed to the carburetor. Tests of the mixture are made exactly as with cars having both gasoline and air controls.

A good, strong spark is absolutely essential to rapid burning of the explosive mixture that passes from your carburetor to your cylinders. Hence, you should see that the spark plugs are kept clean and free from carbon. They should be cleaned occasionally by immersing them in kerosene and removing the carbon with a small, stiff brush — a typewriter type brush or a toothbrush with stiff bristles will serve—or they should be scraped with a pocket knife, nail file, or some similar small, sharp tool.

Adjusting the Points

The points then should be filed bright and adjusted to .025 of an inch—about the thickness of a well-worn dime. Your battery also should be kept properly charged, and, if you have a magneto in your car, the carbon dust should be cleaned out occasionally.

Valves should be ground more or less frequently, depending on the use you make of your car, to make them seat well. Sometimes it is leakage at your valves and not a lean mixture that causes your carburetor to pop.

These, then, are some of the secrets of getting more miles to the gallon—very open secrets. None of the operations I have mentioned requires any extraordinary amount of labor or trouble. They are all things you can do yourself. If you don't care to tinker with a car, though, you can have any of the above adjustments made in a service station, and the gasoline you will save should defray the cost of making the adjustments. In fact, you probably will make a profit; not necessarily through your saving in fuel, but because you will have a smooth-running, dependable car that will serve you whenever you call upon it.

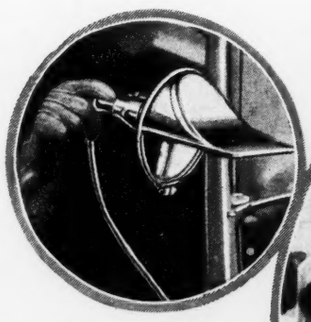
NEXT month—The steering mechanism and its operation; how to keep it in good working order for your safety and comfort.

ONE way to get more miles to the gallon and to keep your car running at highest efficiency, Mr. Platte points out, lies in having your carburetor always in proper adjustment.

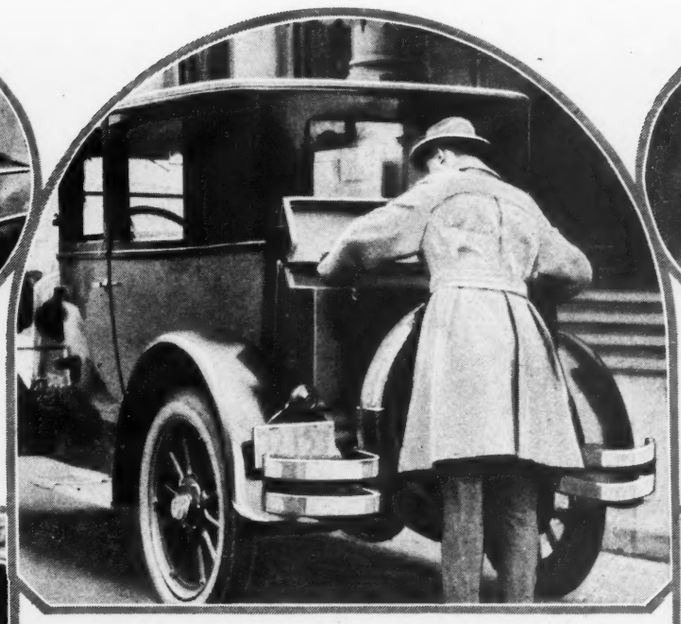
Mr. Platte has explained the general principles by which such adjustments are made. If you should wish more specific instructions, send a stamped, self-addressed envelope for reply to the Automobile Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y., giving the following information:

Make of car. Model. Year.
Make of carburetor. Identification number.

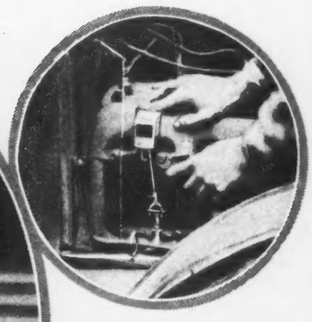
Springtime Hints for Auto Touring



To prevent blinding glare, this spotlight is supplemented by a second lens and reflector at the top which deflect all upward rays downward to the roadway ahead

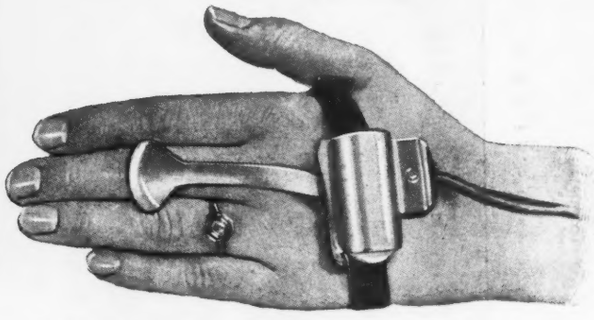


Small but sturdy circular bumpers attached behind the two rear fenders, are said to protect the car as adequately as the ordinary bumper, while affording easier access to spare tires, luggage, gasoline tank, and grease cups

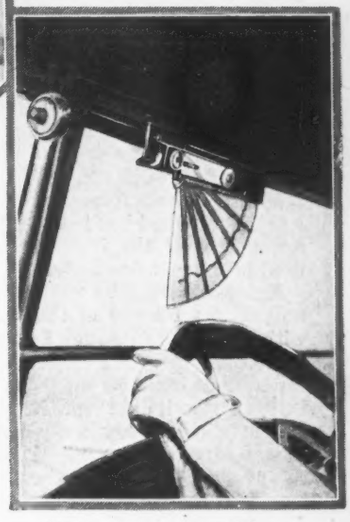


Automatic carburetor control is accomplished here by a coil of thermostatic metal that expands or contracts according to the engine heat, regulating the gas

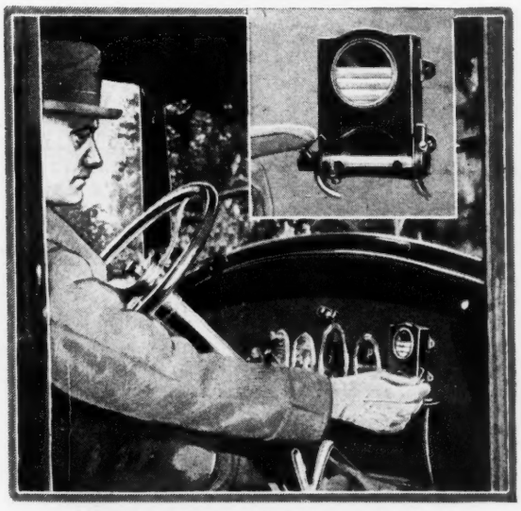
This pivoted hood of composition material serves as both deflector and windshield wiper. It also protects the driver's eyes from intense sunlight or from the glare of approaching lights



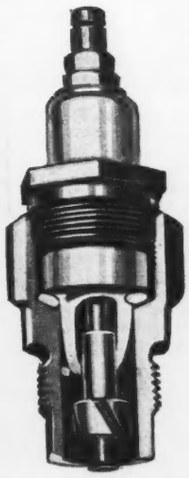
Hand signaling at night is made effective by an ingenious light attached to the back of the driver's left hand. When the hand is extended, the second finger moves a lever that switches on the dash-connected light



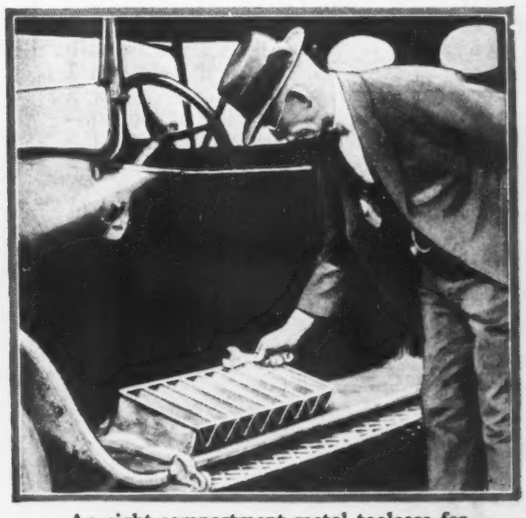
When not in use, this new anti-glare automobile shield folds up like a fan into a metal container attached to the top of the windshield. When fully extended, the shield forms a quadrant



When the driver pulls a lever, this dashboard cigarette holder ejects one of its 15 cigarettes and simultaneously lights it



This spark plug automatically cleans itself. A spiral plunger moves with each impulse of the piston, preventing the collection of carbon



An eight-compartment metal toolcase for the autoist collapses to a size that can be put in the pocket. It is wrapped in canvas

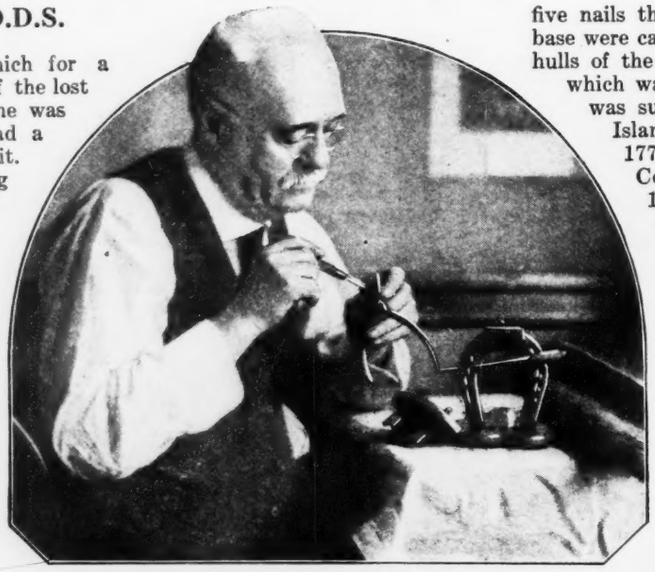
Fun and Profit in My Jack-Knife

By C. J. Reynolds, D.D.S.

JACK-KNIFE whittling, which for a time appeared to be one of the lost arts, is coming back. Time was when every American man had a jack-knife and knew how to use it. This skill, acquired through long practice, stood him in good stead in many emergencies throughout life.

For my own part, I consider time I have spent with my knife entirely well spent, and I am glad to see the art of wood-carving revived. In fact, a great deal of such success as I have had is directly traceable to it. The manual dexterity I acquired through using a knife has been tremendously useful to me in the practice of my profession—dentistry. For one thing, unlike many of my brother dentists of the present day, I do all of my own laboratory work. And the ingenuity developed through fashioning intricate objects from shapeless bits of wood has led to my inventing not a few of the instruments that are used in modern dentistry.

But aside from its usefulness, there is no pastime I know of that is so replete with pleasure. Although I was only eight years old when first I started to whittle, the pastime holds for me today as keen an enjoyment as it did then. Many evenings, after a laborious day in my dental laboratory, I turn with a sense of genuine relief to the good old jack-knife that I have treasured for the last 18 years.



Dr. C. J. Reynolds, Pittsburgh dentist and inventor of dental instruments, whittling the penholder and inkwell he carved for the late President Harding from wood taken from the old United States war-ships *Revenge, Royal Savage, Niagara,* and *Lawrence*

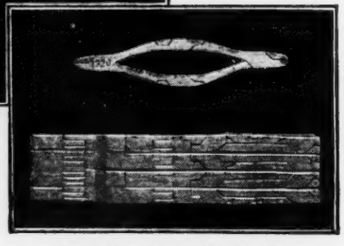
A Trophy of Revolutionary Days

Not long ago I read in the newspapers that Mr. S. H. P. Pell, of New York, who has a summer home at Fort Ticonderoga, on Lake Champlain, had salvaged the old hull of the war-ship *Revenge*, which had been sunk by American ships on October 10, 1776. I asked him to send me a piece of wood from the old ship. Mr. Pell answered my appeal by sending me a rib of oak from the hull, and from this I carved an inkstand, in the shape of a horseshoe to match a chair that 600 newspaper editors had had made from the timbers of the *Revenge* as a gift for President Harding. I mounted the horseshoe on a base that I carved from pieces of wood from three old American ships. The five nails that affixed the horseshoe to its base were carved from wood taken from the hulls of the American ships, *Royal Savage*, which was Arnold's flag-ship and which was sunk by the British off Valcour Island, Lake Champlain, October 11, 1776; the *Lawrence*, which was Commodore Perry's flag-ship in 1812, and *Niagara*, another one of Perry's ships.

The inkstand completed, I sent it to President Harding, and I received in reply a warm letter of thanks.

Among the other novelties I have carved with my jack-knife are a wooden mask of myself, which friends have pronounced an exact likeness, and an oil-drilling plant, fully equipped, inside a large bottle, which can be set in operation by turning the stopper in the neck of the bottle. This piece of work causes great wonderment as to how the plant was set up inside the bottle. I have also whittled a chain of eight twisted links, all cut from one round piece of wood, size six inches; six interwoven rings cut from one block of wood, three by five inches; a set of four-joint pliers, cut from one piece of wood; a set of multiple, jointed pliers, containing 83 separate joints, all cut from one piece of wood, two by three by 10 inches; and a "ouija" board, made from a piece of the *Revenge*.

Four of Doctor Reynolds' penknife creations, each cut from one piece of wood—a chain of eight interwoven rings; a chain of six interwoven rings; four-jointed pliers, and remarkable multiple pliers containing 83 separate plier joints



Here the four-jointed pliers (top) and the 83-jointed multiple pliers are shown with the pliers closed. Each was carved by Doctor Reynolds from a single piece of wood

Procure the Right Knife

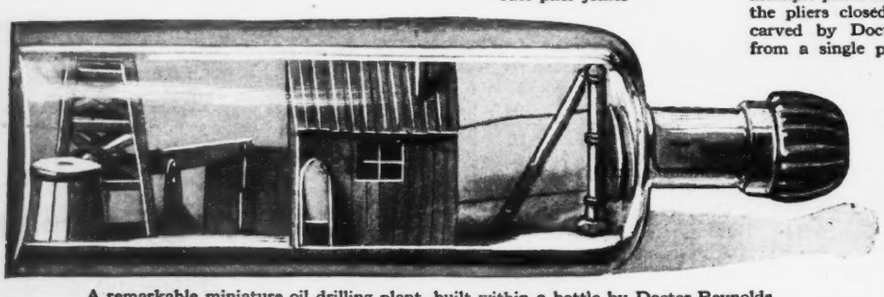
Not any knife, of course, will do for whittling. I have had many makes in my life.

The best I have found is a modern, patented pushbutton knife. The fact that the blades of this knife lock, both when open and shut, eliminates the danger of the whittler's cutting himself.

In sharpening a knife, I wear it down to an edge on a rough stone, then put a 30-degree bevel on it by means of a fine, smooth Arkansas oilstone. Then I strop the blade until I have an edge that will shave. I have several knives whose blades I have ground down to almost nothing in order to accomplish certain whittling tricks.

It is a fascinating hobby, and I'd advise every man to try it.

As for fathers of sons, aye, and of daughters, too, I'd advise every one of them to buy for a child a jack-knife as soon as he can handle it with a reasonable amount of safety. Of course he will cut himself at first, but it will not take him long to learn how to handle a knife, also it will teach him something constructive, and there's no telling when an unexpected genius will be discovered.



A remarkable miniature oil drilling plant, built within a bottle by Doctor Reynolds. The plant can be set in operation by turning the stopper of the bottle

The Home Workshop

Arthur Wakeling, Editor

Modern Dining Alcoves that Save Labor

THE dining alcove is a feature of the modern home that has come to stay. It saves valuable space in a time of housing shortage and high building costs. Even more important, it reduces materially the amount of walking back and forth necessary in serving breakfast, luncheon, and other informal meals.

Some of the most modern small homes have built-in Pullman dining alcoves, located in or adjacent to the kitchen. This is particularly true of the newer type of house in which the dining-room is combined with the living-room or is merely an extension from the living-room. The value of a separate dining-nook for the informal meals in such cases is obvious, but in many old houses a dining alcove of the type illustrated is equally valuable.

The older houses often have kitchens that are too large from the modern viewpoint, when experts count every footstep the housewife takes and when so many mechanical appliances and compact kitchen cabinets are used. In such a kitchen there is often a light, pleasant corner in which a dining alcove might be constructed to advantage by any man handy with woodworking tools.

Fig. 1. Working details of this attractive breakfast nook are contained in Popular Science Monthly's Blueprint No. 33

The two designs illustrated can be adapted to suit almost any house, new or old. They were prepared especially for POPULAR SCIENCE MONTHLY by George F. Kaercher, an expert on furniture design, after long study of this type of built-in furniture. Consequently, they embody the latest ideas in construction.

Adapted for Use in Any House

It is not essential that there should be an actual alcove or jog in the kitchen to take either of these dining-nooks; they can be placed in a corner or even against a plain wall. The design shown in Figs. 3 and 4 (the latter on page 129), being quite solid and substantial, is especially good against a plain wall, since it has the effect of creating an alcove. It is most effective if there is a window at the end of the table.

The design shown in Figs. 1 and 2 is of more open construction and is better adapted for use in a corner or recess. Each set consists of a simply made and very substantial table and two identical benches with high backs.

The bench of the design shown in Figs. 1 and 2 stands 3 ft. 6½ in. high over all, and is 4 ft. 6 in. long and 1 ft. 9 in. wide. The seat is the usual 18 in. above the floor. Neither these nor any of the following dimensions have to be adhered to exactly, as some modification in the over-all sizes may be advisable to suit certain requirements, but on the average they represent the most practical proportions.

The stock to be used may be white pine, whitewood, cypress, chestnut, or any other easily worked wood.

The seats are 1⅛ by 20 in. by 4 ft. 6 in. The back legs, which run to within ½ in. of the top of the seat backs, are 1¾ by 1¾ in. by 3 ft. 3¾ in., four being required. Taper them back above the seat level as shown in Fig. 2. The front legs are 1¾ by 1¾ by 14⅝ in.

The legs are connected, as indicated, by means of a back rail 1⅜ by 2½ in. by 4 ft. ½ in. (one being required for each bench), a front rail 1⅜ by 2½ in. by 4 ft. 3 in., notched at the ends, and two end rails 1⅜ by 2½ by 18¾ in., also notched.

The legs of each bench rest upon two base feet 1¾ by 2¼ by 20½ in. These feet are connected by two stretchers ⅞ by 2½ in. by 4 ft., four being required

(*Continued on page 129*)

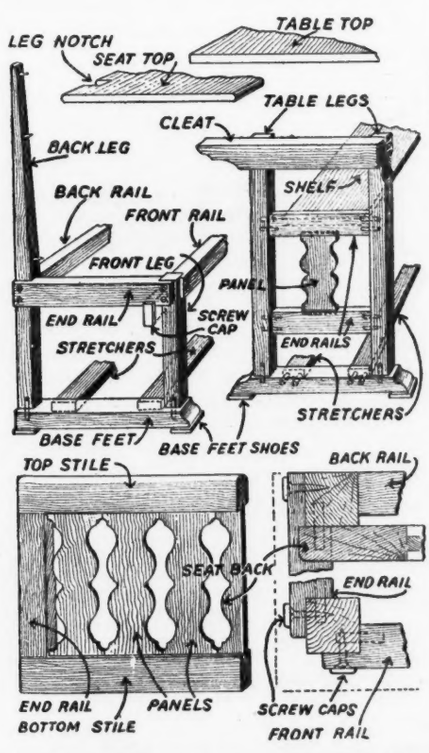


Fig. 2. How the parts of the table and benches shown in Fig. 1 are put together

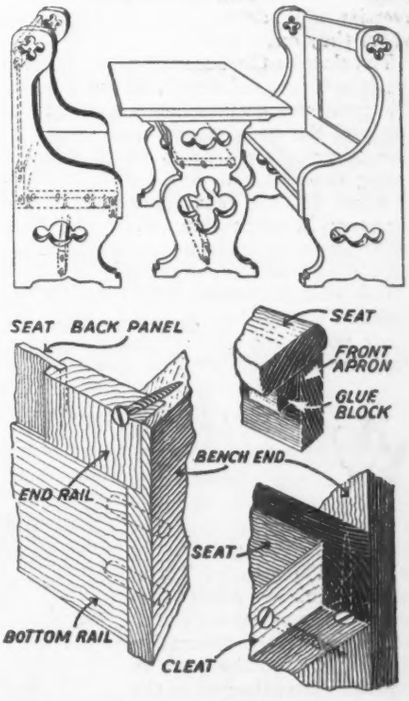


Fig. 3. Another decorative type of breakfast alcove with solid bench and table ends

Attractive "Habitant" Chairs Are Built Easily

By Stanley W. Blanchard

UP IN Quebec, the home of the French-Canadian, the habitants still order their lives very much as did their fathers before them and, if need be, make their own furniture. It is one of these pieces of furniture, a chair (Fig. 1), that I shall describe.

Typically habitant, this chair is seen in many of the homesteads of the French-Canadian farmer and partakes of his virtues—it is strong, rugged, and durable. The marks of hand tools add rather than detract from the character of the piece.

These chairs have become popular with many who have seen them and are frequently used as porch furniture or in a dining or breakfast room when painted to match the color scheme.

The woodwork (Fig. 2) will offer no difficulties to the average amateur. Use straight-grained hard wood and good strong glue to hold it together. The

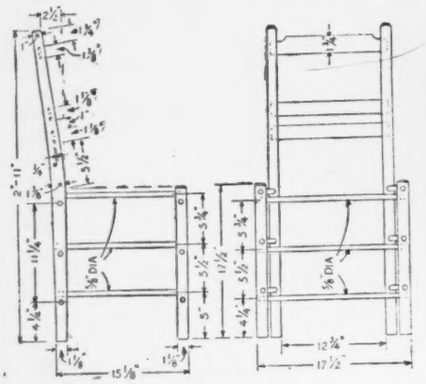


Fig. 2. Side and front views of a typical "habitant" chair with essential dimensions

back legs may be cut from one plank to economize on lumber. The rungs may be ordinary ⅝-in. dowels, but it is more in keeping with the style of the chair to split the rungs yourself from a straight-grained piece of ash, leaving them slightly oversize and dressing to fit the holes where they enter the legs.

The slats in the back are mortised into the legs to a good depth, at least ¾ in. The rungs are set completely through the legs and the ends planed flush after the glue is dry. Care must be used when boring the holes on the sides of the legs to allow for the fact that the chair is narrower in back than at front. The surest way is to make a wooden guide for the bit.

The seat is woven from rawhide or *"babiche,"* as the habitant calls it. When you recall that the early Western pioneers successfully used rawhide for tires on their wagons in place of iron, some idea of its durability may be had. The seat also may be woven with strong cord or made of strips of soft flexible leather, 1 or 1½ in. wide, glued and tacked to the rungs and the strips woven

Fig. 1. This chair combines strength and the charm always associated with fine handwork

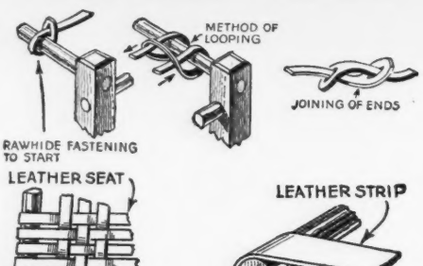


Fig. 4. Details of the rawhide seat and alternative method using flat leather strips

in simple "over and under" fashion, as shown at the bottom of Fig. 4.

Weaving a rawhide seat, however, is not as difficult as may appear at first glance, and any one who makes this chair and seats it with rawhide will have the satisfaction of knowing that he has made an exact replica of a real habitant chair.

First obtain a quantity of rawhide strips about 3/16 in. wide or get a hide and cut them yourself if you wish. Keep the strips wet all the time until the seating is completed. At any time that you leave the chair for very long, cover the seat with a damp cloth.

Take a position in front of the chair and mark lines on each top rung (Fig. 3) to show where the rawhide passes around the rung. The side and back rungs have 23 lines each and the front rung has 21 lines. Space the lines an equal distance apart and start and finish close to the leg at each end of the rung.

Now number the lines as shown. In this way any particular mark can be designated. Thus, the mark *L1* refers to the left rung, first mark, and *B13* refers to back rung, thirteenth mark.

Start the weaving at *L1*, fasten one end of a rawhide strip, stretch it across to *R1*, and loop around the rung (Fig. 4). Use this loop every time you pass a strip

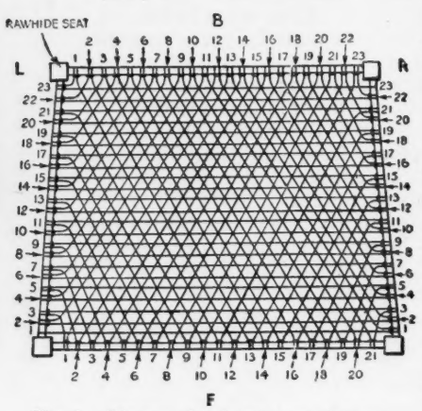


Fig. 3. Diagram showing the seat of woven rawhide, numbered to simplify the work

around a rung. From *R1* go to *B12* and then as follows: *B12* to *L2—R2—B13—F1—L3—R3—F21—B11—L4—R4—B14—F2—L5—R5—F20—B10—L6—R6—B15—F3—L7—R7—F19—B9—L8—R8—B16—F4—L9—R9—F18—B8—L10—R10—B17—F5—L11—R11—F17—B7—L12—R12—B18—F6—L13—R13—F16—B6—L14—R14—B19—F7—L15—R15—F15—B5—L16—R16—B20—F8—L17—R17—F14—B4—L18—R18—B21—F9—L19—R19—F13—B3—L20—R20—B22—F10—L21—R21—F12—B2—L22—R22—B23—F11—B1—L23—R23*, which is the end.

Weave carefully over and under as you go from one point to another; if this weaving is done correctly, a six-sided pattern will result. The last strip may be tied to the rung at *R23* and any surplus cut off.

After the rawhide is tight and dry, give it a few coats of shellac and stain or paint the woodwork as desired.

Box Hinges Cut from Sheet Metal

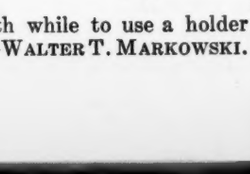
ONE of the simplest box hinges that can be made in the home workshop is that illustrated. It requires only two small pieces of brass, copper, tin, or other thin metal. The pieces are cut as shown or in any decorative shape that suits the work in hand, and are attached to the lid with escutcheon pins.

The pivot end of each piece is then fastened to the box with a round head wood screw.

Besides its simplicity and cheapness, this hinge has an advantage in very light work because it reinforces the lid where most necessary. Another advantage is that the lid can be turned well back without straining the hinges.

Replacing Cartridge Fuses

TO AVOID the danger of shock and burns in removing and replacing cartridge fuses in a crowded electric panel board, it is worth while to use a holder made as shown.—WALTER T. MARKOWSKI.



A cartridge fuse holder

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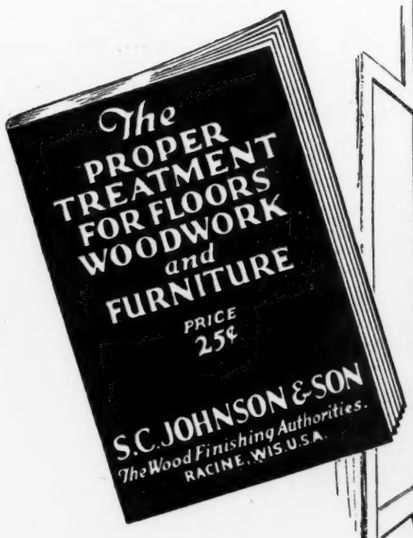

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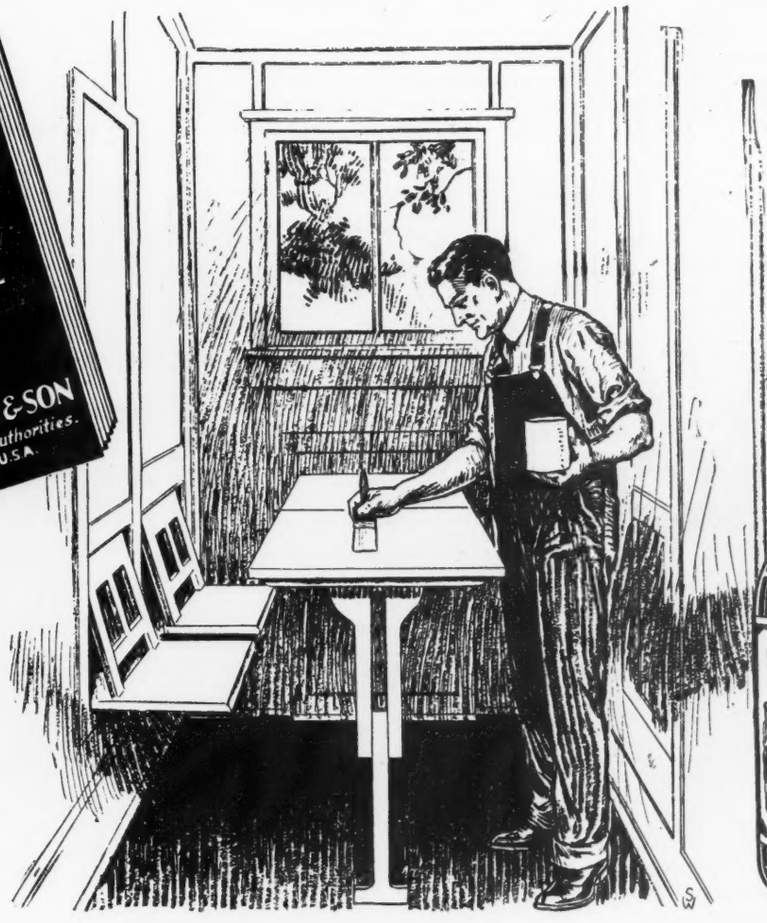

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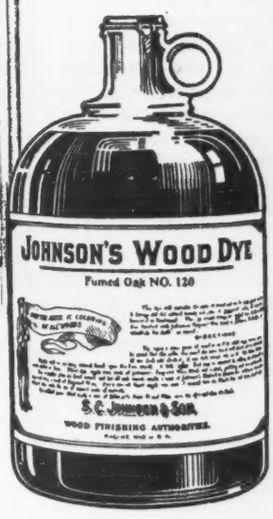

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Tricks Every Woodworker Should Know

By Edwin M. Love

EVERY man sooner or later undertakes some woodwork repairs about his house or apartment. He may wish to build a wainscot of "ceiling" boards in his laundry porch to protect plaster that has been weakened by the water continually splashed upon it. He may have to replace the picture molding, or put more shelves in a clothes closet. In each instance there are "tricks of the trade," generally unknown to amateurs, by which a carpenter simplifies and hastens the work, and a few of these methods are explained below.

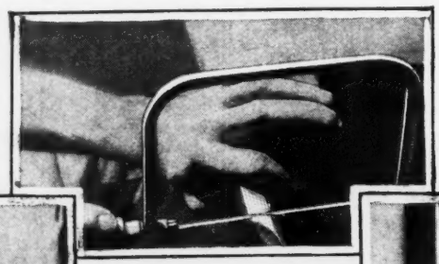
In putting down plain baseboard — the wooden guard that protects the wall from damage at the floor line — the simplest method of marking for cutting against a door casing is to use a so-called "preacher" or base hook. It is simply a wooden fork made as shown in Fig. 5 (for ⅝-in. thick base). This is straddled over the boards, pressed against the back or outside edge of the casing, and marked down the front leg. A board so marked is usually long enough to allow a tightly pressed joint, which should fit on trial. Care should be taken not to cut the piece too long, however, as the pressure may force the jamb and cause the door to bind.

Having nailed the first piece of baseboard solidly, measure for the length of the second with two sticks, sliding one stick over the other, telescopic fashion, to make a rod of exactly the right length. Then mark and cut the board ¼ in. longer to allow for scribing. Put the board in place as nearly as possible. Force the end to be cut against the wall and press it against its mating board in the corner. Then, holding a pair of dividers with legs ¼ in. apart, as indicated in Fig. 4, draw steadily up from bottom to top, thus tracing a line exactly parallel to the face of the first board. This is, by the way, the general method used whenever it is necessary to fit, or, as a carpenter says, scribe a piece of wood to fit another irregular piece, or to go up against a plaster wall, which is almost certain to be more or less wavy or out of plumb.

Cutting to the Scribed Line

Saw off the baseboard from the bottom edge to where the round edge begins at the top and finish the cut with a coping saw (often known to amateur woodworkers and manual-training boys as a fretsaw) to make a curved projection to fit the round on the other board. If by mischance the board is cut a trifle short, wedge from the other end, as this gap will be hidden behind the end of the board on the third side of the room.

Where a chimney or other projection jogs into the room, cut all the pieces necessary to go around, and tack in place; then, if any fail to fit, they can be removed easily. Amateurs nearly always cut these mitered pieces too short, owing to the fact that the plaster usually slopes toward the corners. Having fitted one end of the first board to be mitered against its neighbor, hold it in place and mark the length



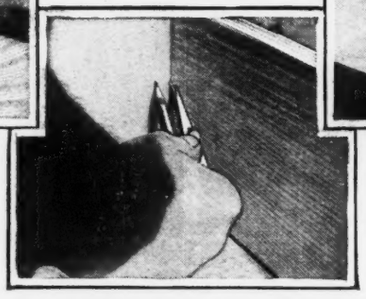


Fig. 1 (above): Cutting a coped picture-molding joint like that illustrated in Fig. 5
Fig. 2 (at left): Marking length of baseboard for a mitered joint
Fig. 3 (at right): Using a base hook to mark baseboard against a door casing
Fig. 4 (below): Scribing baseboard in a corner

with a straight edge held against the plaster, as in Fig. 2. This is the back of the miter, which is cut straight down the face; the plaster can be chipped out from below or the board blocked out, if necessary. Nail the joint from both directions with small finishing nails.

In nailing down base, locate a stud by sounding the plaster or wallboard with a hammer before placing the board, so that any scars in the surface will be covered. Verify by driving home a nail and then lay off distances of 16 in. both ways (as studs are usually 16 in. apart) to show where nails are to be driven.

Substantially the same method is followed in applying any flat bands, such as chair rails and wainscot caps.

In putting up picture molding, never miter the inside corners, as they always open up and look badly when the wood dries and shrinks. Instead, nail up pieces of molding on opposite ends of the room and cope the ends of the other two pieces (Fig. 5) to fit, cutting them slightly long so that the joints will squeeze tightly together.

To get the outline for coping, merely miter or cut the end of the molding at an angle of 45 degrees in a miter box. The sharp edge formed by the intersection of the cut with the molding's profile will give the line to be coped. It merely has to be followed around with a coping saw. All moldings can be coped for right angle joints in precisely the same way.

If, because of unevenness of the plaster, a picture molding joint remains open on the top, it often can be closed by driving a wedge behind the projecting lip of its mate (Fig. 5). Always undercut mitered joints sharply at the back, so that no wood at the back of the molding will prevent the front edges from closing.

Picture molding generally is put within ⅜ in. of the ceiling, a distance easily gaged with a small strip of wood. If it is to be any appreciable distance below the ceiling, the corner points should be located at equal distances from the ceiling and a chalk line struck between them to insure straightness in nailing up.

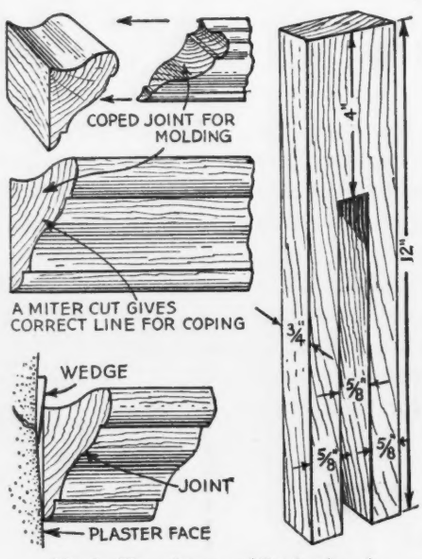


Fig. 5. How picture molding is mitered and coped, and detail of a base hook

Allowing for Misalinement

Should the window and door headers be much out of alinement, or the ceiling out of level, it is best to divide up the distances so that the molding will run approximately parallel. If it is run level with the cap molding on the door and window headers, replace the cap mold with molding of the same pattern as the picture mold, and cut the pieces on the wall to fit between the "returns" of the cap molding.

The small molding known as base shoe, which fills in the corner between the floor and the baseboard, is coped like picture molding and tacked against the floor and the baseboard. It is cut off square against the door casings, or, if it projects beyond the face of the casings, rounded slightly.

FEW homes are without a door or two that persistently binds or sticks. Mr. Love will tell the simplest methods for fixing doors in an article in next month's POPULAR SCIENCE MONTHLY.

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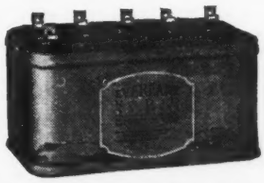

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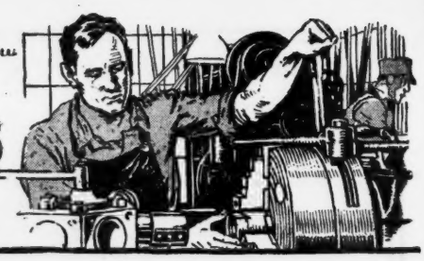


Some Secrets of Success in Hardening Steel

By J. A. Horton, M.E.
Designer of Rolling Mills and Special Machinery

IN HARDENING small tools and dies that have small projecting parts, the breakage is very great, and many ideas are suggested to prevent or reduce this loss. As a toolmaker and also a die-maker, I have tried many so-called hardening compounds and especially prepared water for this purpose, and have found the following to be for me the best and usually the easiest to find in the ordinary machine shop:

Take common hard soap, just what would be used to wash the hands with. Heat the tool or die very slowly and be careful not to allow any small, projecting parts to get too hot. If heated beyond a cherry red, the small part will have some of its carbon burned and this will impair the cutting quality and it will not keep sharp as long as the major portion of the tool or die.

Daub with Hard Soap

Clean cold water should be at hand for quenching, but do not dip the tool as soon as it is heated. The small projecting parts, being thinner than the body, would cool too quickly and when the main parts cooled, the strain would be apt to crack the small part adjoining the body and it might drop off.

Instead, the small projecting parts are daubed with hard soap and then immediately immersed in the water before the gas generated from the soap has passed off. The water does not come into full contact with the steel until the gas is gone, and this keeps the small portion from getting too hard before the main body is hardened.

While in England a few years ago, where I had gone as consulting engineer supervising the construction of a mill, and later had become its superintendent, I had occasion to have a small forging hardened on both ends and softer in the middle.

This piece was about 3 in. long and 1 in. in diameter. When I asked the blacksmith to do this, he looked at it and said:

"If I heat one end and harden that, when I heat it to harden the other end it will draw the temper from the hardened end, and if I harden it all over, I cannot draw the temper in the middle without also drawing it from the ends."

I asked him to heat it and to allow me to dip it. A piece of soap lay on his forge. I had his cooling tub filled with clean water, and, when the forging was sufficiently heated, I rubbed it around the middle with the soap and dipped immediately.

How he did laugh at me! But when the forging was cold, I handed it to him to make a file test. He found it much softer in the middle than at either end, just as I wished it to be.

The blacksmith remarked that he had been working at his trade for 30 years and had never seen soap used in this way to keep steel from hardening.

As another illustration: Take a die on which a face is to be reproduced, with the nose quite prominent. As it is not practical to engrave into the depressed die, a hob is made the reverse of the die and it is then quite easy for the die engraver to give the desired expression to the face.

It now becomes necessary, however, to harden the hob so that it can be transferred to the actual dies. I have seen a number that have had the nose broken off in the hardening process and, of course, the hob was lost; whereas, if the nose had been daubed with hard soap just previous to dipping in the water, the loss by breakage would have been lessened materially, if not prevented entirely.

In hardening dies of larger sizes, such as are used in a drop hammer—especially those that have a large amount of engraving and necessarily are expensive—the risk becomes a serious matter. The first impulse is to dip a die of this type quickly endwise into the water. It will come out looking pretty well but then may crack and be spoiled. Some experts use a special solution, especially iced brine, but still lose a large percentage.

Treatment for Costly Dies

The writer has spent more than $100 on a die and sent it to specialists whose process was to turn the die face down and bring up under it a stream of water for quenching purposes. The die came back cracked the whole length.

I experimented and found the following to be very satisfactory:

First, an engraved die must not be heated hot enough to harden in a furnace or fire where the atmosphere can reach it, as it will cause the finished engraving to oxidize and, when cooled, it will most likely scale and cause trouble in bringing back the polish. To avoid this, surround the die with an iron hoop projecting above the face surface of the die about ½ in., tight enough to stay up, but not so tight that it cannot be lifted off with a pair of tongs when hot. Now fill the box formed by the hoop with bone black to the level of the top of the band. This will keep the air from coming into contact with the face of the die while heating.

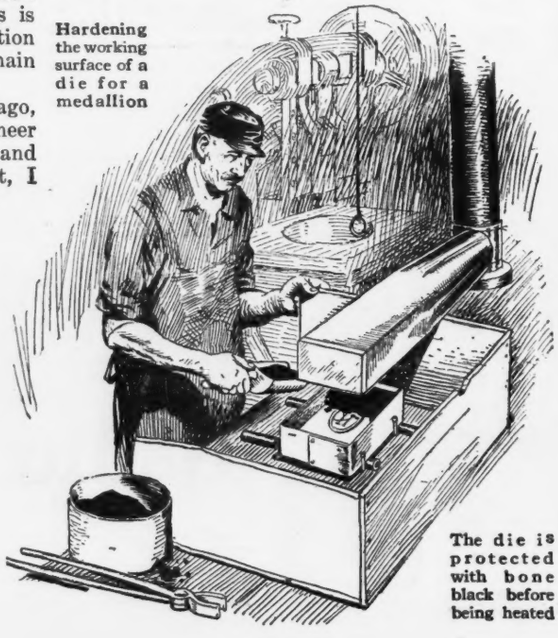
Prepare a box of suitable size, and take one side off to allow water to escape freely. Lay two pieces of iron pipe across the bottom on which to place the hot die and provide pins or nails to locate the die. Place the box, when complete, in a position convenient to a water sup-

(*Continued on page 100*)

COULD YOU DO THIS?

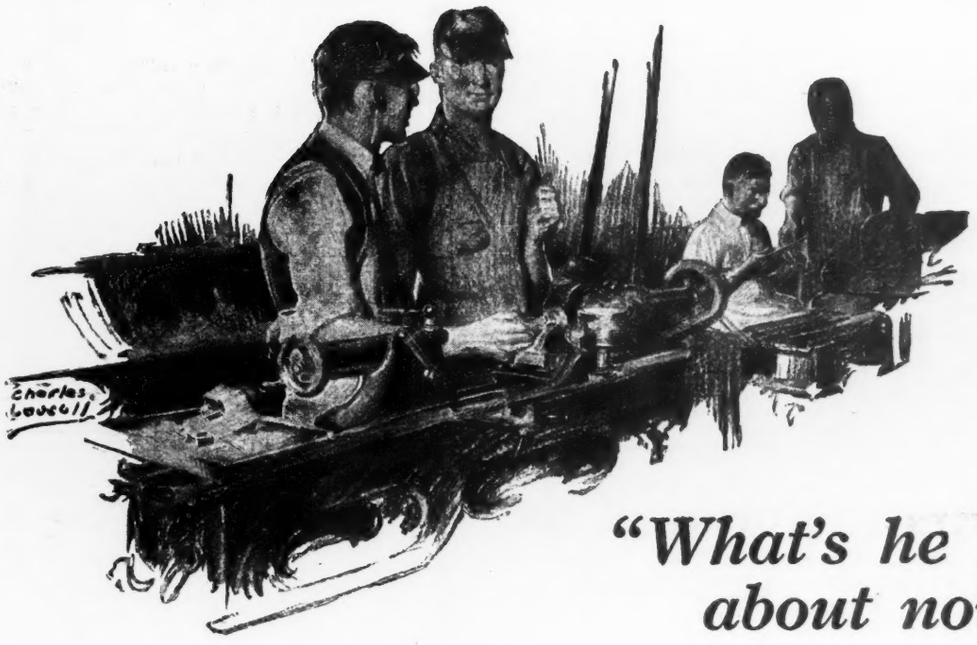
SUPPOSE you had a small steel forging about 1 in. in diameter and 3 in. long and wished to harden it at both ends, leaving it soft in the middle. You needed the piece immediately and had only ordinary equipment to work with. Could you do it?

Mr. Horton tells how he once astonished an old blacksmith by doing the trick, which is very simple and useful.



Hardening the working surface of a die for a medallion

The die is protected with bone black before being heated



"What's he kicking about now?"

"Same old thing. 'Nother job came back on him and he's grouching about the light again."

"Funny he doesn't seem to learn by experience. If he'd use *Starrett* scales like everybody else in the shop he would n't have any trouble getting accurate measurements —even if the light *is* poor."

Hardened and Tempered

A Real Achievement

Back in 1882 The L. S. Starrett Co. started something. A line of light, spring tempered steel rules was introduced that won instant favor with machinists and mechanics. They saw at once the advantages of these new Starrett rules over the thick soft rules then in common use. Starrett Rules were adopted everywhere.

42 years of Progressive improvements has kept Starrett still out in front. Today this leadership is strengthened even more by the introduction of the Starrett Stainless Steel Rule—a rule that not only won't rust or stain but is *hardened and tempered* possessing the very finest wearing qualities.

Like all Starrett Steel Rules the figures and division lines are clear and distinct. They're cut deep enough to be easily read after years of hard service. Starrett Rules make it easier to do accurate work. Write for Catalog No. 22-"W" for description of the different styles, graduations, etc.

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No. 1000
Will not RUST OR STAIN. Hardened and Tempered

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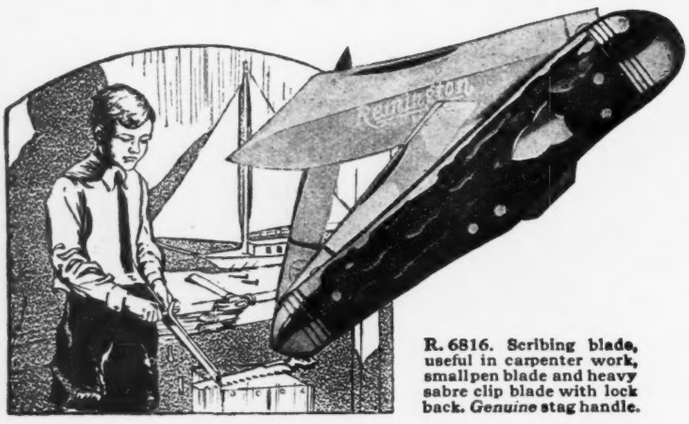
Use Starrett Tools



R. 6816. Scribing blade, useful in carpenter work, smallpen blade and heavy sabre clip blade with lock back. *Genuine* stag handle.

Here are Knives worthy of the Up-and-doing American

GOOD craftsmen were quick to sense the fact that Remington Knives are real tools.

Made up to the standards of what a man needs and expects in a knife.

Remington Knives are Remington through and through—keen cutting, strong, lasting knives. All the century and more of Remington's development in the hardening, tempering and making of steel goes into each blade.

Look at the Carpenter's and Mechanic's knives illustrated—husky, sharp, lasting tools for the handy man.

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To make sure of getting a Remington see that the name Remington is stamped on the heel of the blade.

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Remington Arms Company, Inc., *New York City*

Established 1816

R. 3693. Blued steel punch blade for drilling holes in leather and general repair work; scribing blade useful for the handy man; heavy sabre clip blade. Stag handle.

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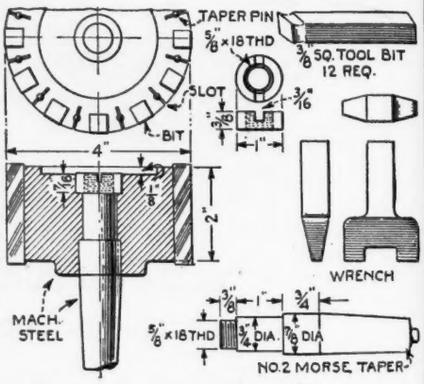
Also Makers of Remington Cash Registers

Making an Inexpensive Face Mill with Inserted Teeth

FACING cutters of large diameter are usually quite expensive. For small shop work the cutter here described will do the work about as well and can be made at perhaps half the cost of a purchased tool.

The body of this cutter and the shank are made from ordinary machine steel. The body first is turned all over as shown and taper pin holes then are drilled and reamed. In the reaming operation care must be taken to have all the holes the same depth.

The next operation on the body is cutting the slots through the centers of



Details of a shop-made face mill, in which the inserted teeth are held with taper pins

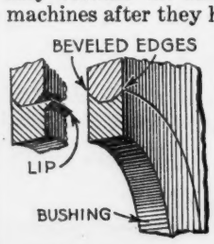
these holes to a sufficient depth to give spring to the intervening sections of metal. The taper pins, when driven home, will spring the two opposing sides together against the toolbits and hold them solidly in place.

The slots for the toolbits are milled out to fit the size steel to be used. For a 4-in. cutter a good size is 3/8-in. square steel. The bits are cut to length and rough ground to shape. After this the assembled cutter should be set up on centers, either on a lathe or grinder, and carefully ground for clearance.

The wrench is forged from a piece of square stock and is simple and easy to make. The points should be case-hardened to give long wear and the mandrel nut also should be case-hardened.—H. W.

Bushing a Circular Saw

IN EVERY woodworking shop are circular saws with bushings made necessary because the saws are used on small machines after they have been worn down or because they are used on other machines than those for which they were at first intended.



How the bushing is held in place

The best method I have found for holding a bushing in a saw, so that it will not be lost, is that illustrated. The eye or hole is countersunk on each side of the saw for one quarter the thickness of the saw, which may be done in a lathe or with a round file, and the bushing is then fitted as shown.—W. A. LYON, Plymouth, Wis.

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Many families already owning the highest priced cars, also own a Chevrolet Sedan or Coupe. They find it not only consistent in style and general quality with their social position, but also astonishingly economical to operate.

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Thousands of pleased owners will tell you a Chevrolet offers the best dollar value of any car made.

Your own requirements for economical transportation will determine your choice of models.

Any Chevrolet dealer will explain their many points of superiority.

Chevrolet Motor Company, Detroit, Michigan

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Superior Roadster	$490	*Commercial Cars*	
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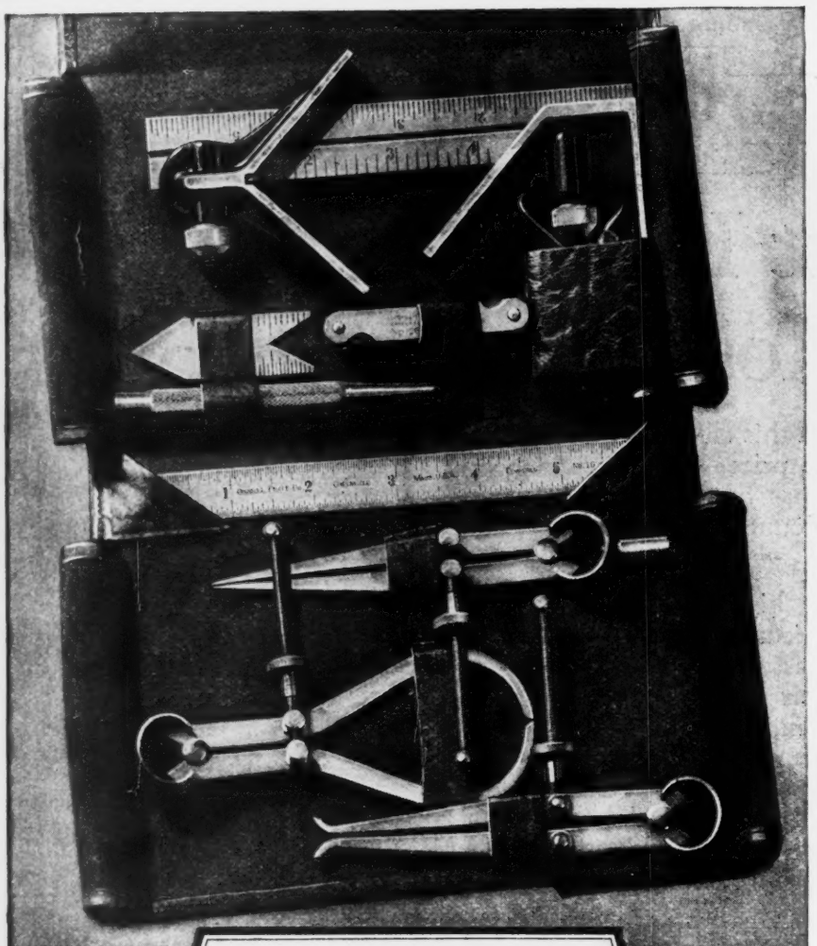

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This kit is a fine example of the 1500 Good Tools made by Goodell-Pratt. Sold by good tool stores everywhere. Write for interesting booklet—*"Tools for the Toolmaker."* It's free.

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Toolsmiths

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GOODELL-PRATT

1500 GOOD TOOLS

Work-Holding Methods that Save a Machinist's Time

MANY simple, time-saving suggestions for machinists are contained in this article, based upon shop ideas developed and used by F. J. Wilhelm, production manager of a Cincinnati firm manufacturing automobile accessories, and Joe V. Romig, machine tool designer and builder. If you are using other ingenious work-holding methods that have equally general application in the shop, send a letter describing them briefly to the Better Shop Methods Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York. For those available for publication our usual rates will be paid.

"HAVEN'T you got that piston done yet?" called Old Bill to his assistant, who had been busy getting a piston ready on a lathe.

Bill went over and found Joe just starting to cut the ring grooves, a job

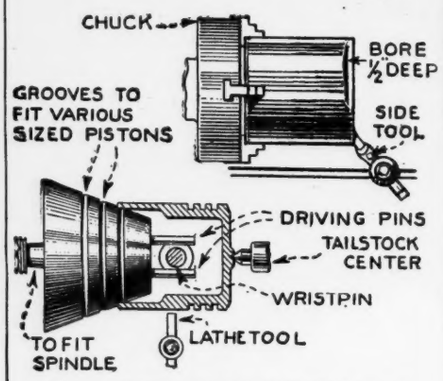

Fig. 1. Regular chuck used for first operation on piston, and mandrel for finishing cuts

that should have been done long ago. A glance showed what the trouble was. Joe had chucked the piston in such a way that the thin walls had been sprung beyond salvage. Joe was a halfway mechanic who had never made a serious study of proper work-holding methods.

"Half the job is holding the work right," was Old Bill's comment, as he proceeded

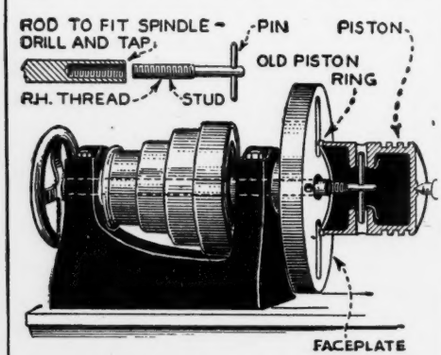

Fig. 2 Turning handwheel draws piston against faceplate for roughing operations

to show his helper how the job should have been done in the first place.

By the use of the right fixtures a piece of work can be held so there will be no springing or slipping, no damaged parts, and no waste time.

A piston casting may be placed in an ordinary chuck, as shown in Fig. 1, while

(Continued on page 92)

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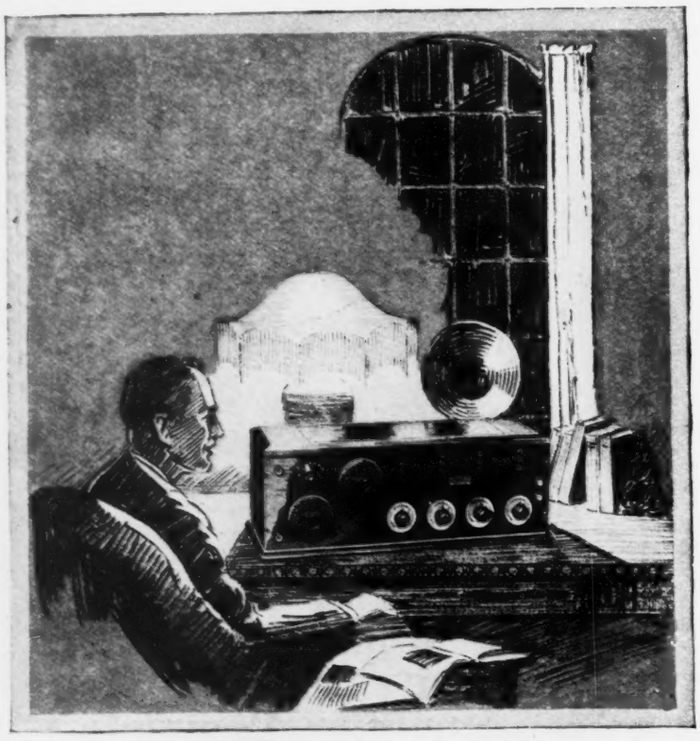

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PWY	Havana, Cuba
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CJCY	Calgary, Can.
KSL	San Francisco, Cal.
KHQ	Seattle, Wash.
KFBU	Lorine, Wyo.
WMAT	Duluth, Minn.
CFCA	Toronto, Canada
CJCI	St. John, Can.
WRP	Dallas, Tex.
NGE	Miami, Fla.
WIAZ	Miami, Fla.
WHAB	Galveston, Tex.
WOK	Pine Bluff, Ark.
WJAZ	Chicago, Ill.
WJAB	Lincoln, Neb.
WMAM	Beaumont, Tex.
WCAG	New Orleans
WLW	Cincinnati, Ohio.
WOQ	Kansas City, Mo.
WGY	Schenectady, N. Y.
WEAB	Dodge, La.
KMC	Tacoma, Wash.
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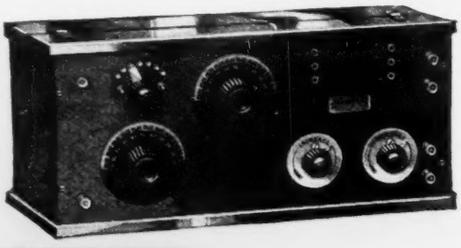

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Work-Holding Methods

(*Continued from page 90*)

the bottom of the skirt is faced off and the inside bored sufficiently to clean up the casting. A fixture then is made to hold the piston to the faceplate. It consists of a rod passing through the headstock spindle and a steel pin that slips through one end of the rod and bears against the walls of the wristpin holes in the piston (Fig. 2).

By turning the handwheel, which has a substantial shoulder bearing against the end of the lathe spindle, the finished face of the piston is drawn tightly against the faceplate and held rigidly. The opposite end of the piston turns on the tailstock lathe center in the usual manner. There is no danger of loosening, since the fixture tends to draw the piston tighter. To allow the portion of the piston nearest the faceplate to be cut without marring the faceplate, an old piston ring is placed in rear of the piston, as indicated.

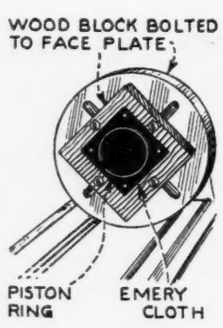

Fig. 3. Emery block for fitting piston rings

Another good method of holding such work is shown in Fig. 1. A mandrel is made with grooves that conform to the diameters of the various pieces to be turned. Pins in the end of the mandrel straddle the wristpin—in a piston job—and drive the work. This is a somewhat quicker method for finishing operations and when the piston is to be ground.

For fitting such parts as piston rings into grooves, the usual procedure is to lay the ring flat and file it. A simpler method is shown in Fig. 3. A piece of emery cloth is fastened to a block of wood, placed in the jaws of the lathe, and the ring is held against it.

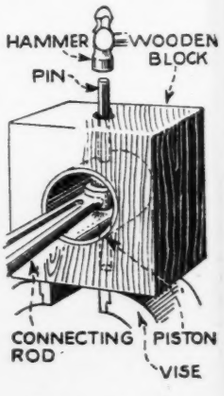

Fig. 4. Fixture for driving out wristpins

After trimming down the lateral faces of a piston ring, so that it fits the groove, it is necessary only to file the joint ends, and this should be done with a file that has one flat side ground "safe."

The wristpin hole can be reamed with a reamer in tailstock chuck or by hand, the piston being held in a vise. A block should be placed between the skirt and the vise jaw so as not to damage the finished surface. The reamer must be kept true by keeping it parallel to the blade of a machinist's square placed on the piston.

A fixture for holding a piston while

(*Continued on page 94*)

WE'VE always believed that Simonds Saws were preferred by men who depended upon saws most.

Now we *Know!*

On a recent trip through twenty-five lumber camps in the Michigan woods, we found that twenty-three used Simonds Saws *exclusively.*

Just you say to yourself NOW, "If it's good enough for the Big Timber Country, it's good enough for me."

And when you go to your dealer be sure to pronounce the name SI-MONDS. Incidentally, if he can't supply you, write us direct, mentioning his name and address. Thanks.

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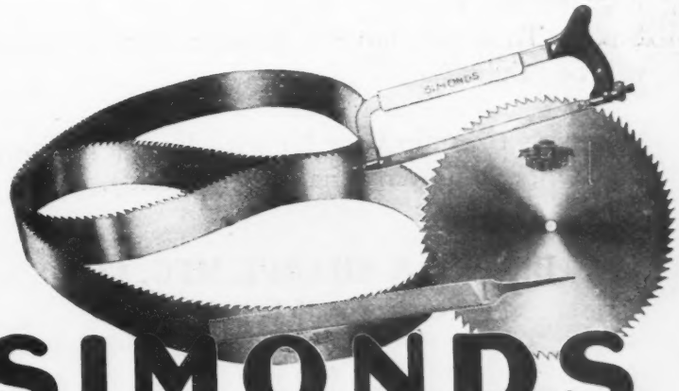

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Now I know why the Boss has confidence in Jones

WHEN an especially particular job comes in, the Boss sends for Jones. Why? Because he knows that Perfection depends upon Accuracy, and for Accuracy he can depend on Jones.

But without the finest and most accurate tools Jones could not be assured of Accuracy. Jones knows this, and his choice every time is "Brown & Sharpe."

Brown & Sharpe Tools are "The Standard of the Mechanical World." When you use Brown & Sharpe Tools you have confidence that the results will be "right."

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BROWN & SHARPE TOOLS

"The Standard of the Mechanical World"

Work-Holding Methods

(*Continued from page 92*)

driving out a frozen wristpin or while reaming in a drill press is shown in Fig. 4.

While these work-holding fixtures can be made from scraps, they are far from makeshifts. They have proved quite satisfactory for a manufacturer who turns out pistons and connecting rods for racing cars.

Another phase of the work-holding question is the use of angle plates and supplementary tables.

Angle plates are subject to great strain and must be heavy and well braced. The most common type is made with two faces at right angles and has one or two 30-degree braces, as shown in Fig. 5. Plain angle plates are usually drilled for clamping bolts as may be needed. Some shops use plates with tapped ½- or ⅝-in. holes in horizontal and vertical lines, equally spaced. When holes are drilled

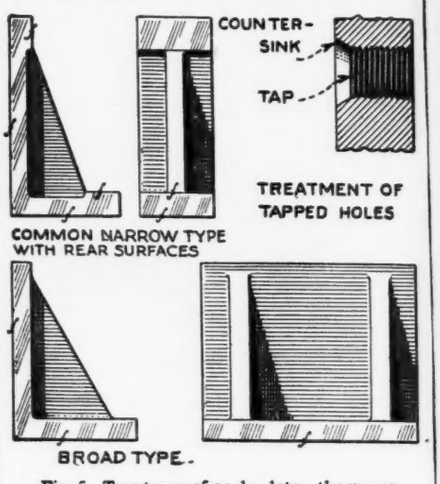

Fig. 5. Two types of angle plates, the upper one having accurately finished rear pads

for the use of studs, they should be countersunk first, as that makes it easier to tap the holes without turning up a burr that might hold the job off square.

A popular type of angle plate with toolmakers and machinery builders is the tall and narrow one shown in Fig. 5. This has machined pads on the reverse side of the faces and at the ends of the sides for making measurements and for square clamping. When the plates are to be used in the vertical position only, they sometimes are fitted with a slot in the base for a holding-down bolt.

A serviceable plate for the accurate machining of pipe fittings and fixtures is the combination box type shown in Fig. 6. It has two faces at right angles and a third at 45 degrees. This plate is open between the faces and is drilled with holes equally spaced so that bolts may be inserted from the inside or nuts be tightened from within. Box plates of this type vary from 6 in. to 4 ft. and larger.

Where work is to be machined while clamped in a vertical position, the tee-slotted plate is an excellent work-holding fixture. Slotted bases are the rule for this type—two slots for one bolt apiece or long slots in which two bolts can be placed.

Supplementary tables are used for work having staggered faces or faces

(*Continued on page 96*)

Iver Johnson Rider

Breaks Cross-Continent Record

CLARENCE WAGNER, of Indiana, holder of the transcontinental record of 28 days 8¼ hours, recently pedaled from Venice, Cal., to New York City in 24 days and 12 hours. He chopped almost 4 days off his previous record. Naturally, Wagner thinks the Iver Johnson is *some* bicycle. It took him over mountains, through desert sand, miles of mud, heavy rains—all sorts of roads and conditions.

Clarence Wagner, who made new transcontinental cycle record from Venice, Cal., to New York City.

Built for long service

The Iver Johnson Truss-Bridge construction assures absolute rigidity, preventing give and sway of the frame during fast pedaling, pushing up hills, or through sand. Also made in Drop-Bar models.

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The two-piece crank set and two-point ball bearings will outlast any other type and make pedaling easy as walking. The crank set is perfectly balanced, accurately aligned, and holds true to adjustment.

Iver Johnson Bicycles are made to fit all sizes of men and women, boys and girls. Colors: Ivory Black, Copper Bronze, Poilu Blue, Iver Johnson Blue, and Maroon. Every model is finished like a high-priced automobile, with five coats of enamel *hand rubbed*, and all nickel plating over copper. Best guaranteed equipment.

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Catalog "B" illustrates and describes the complete line of Iver Johnson Bicycles, as well as Iver Johnson Velocipedes.

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You Need Good Tools

PLIERS—Over sixty styles
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All highest quality drop forged steel.

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Forged steel, hardened and tempered.

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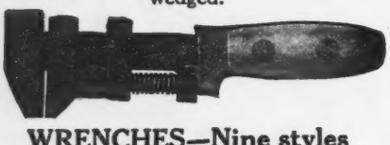
White Hickory handles securely wedged.



WRENCHES—Nine styles
All practical sizes.
Designed for strength.

IN order to work successfully at a mechanical trade or to take pleasure in making things at home you need good tools, tools that will stand up and do the work required of them.

You can't go wrong on a Pexto Tool. They are highest grade, carefully finished, thoroughly tested and inspected and fully guaranteed.

The line consists of Bit Braces, Auger Bits, Squares, Chisels, Hammers, Hatchets, Pliers, Monkey and Pipe Wrenches, Angle Wrenches, Screw Drivers, Snips, Compasses, Pruning Shears, Dividers, Calipers, Pincers, Soldering Coppers, Nail Sets, and many other small tools.

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PEXTO TOOLS are carried by practically all progressive dealers.

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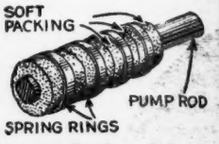
[WORTH WHILE TOOLS

The Peck, Stow & Wilcox Co.
Southington, Conn., U. S. A.

Packing a Worn Rod on a Large Steam Pump



WHEN a piston-rod is badly worn, it is practically impossible to keep a steamtight joint with ordinary packing methods. I have obtained excellent results by using hard brass rings about 1/16 in. thick and two thirds the width of the packing rings. The ends of each of these springy rings are ¼ in. apart after they are placed over the packing. Cut the packing the proper length to go around a rod, place one of the brass rings over the packing ring and insert both into the packing box. Continue until the stuffing box is full. The packing will conform to the worn rod without excessive friction.—JAMES E. NOBLE.

Work-Holding Methods

(*Continued from page 94*)

lying in two planes. Work having arms or extensions that prevent it from being clamped flat to the worktable, is held conveniently in such a table. When clamped to a planer or shaper table, the supplementary table will hold the work parallel to the machine table as well as square with it and it is more desirable than box parallels or wooden supports for high work. These extra tables are made with tee-slotted faces, as indicated in

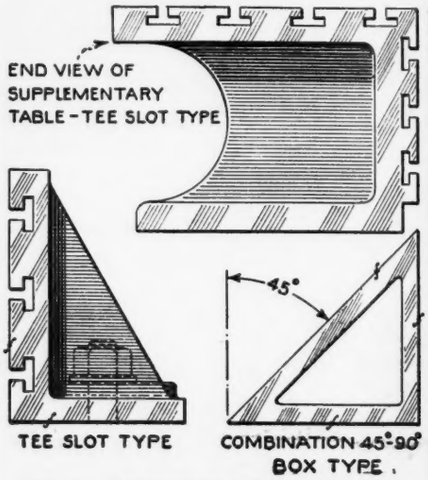


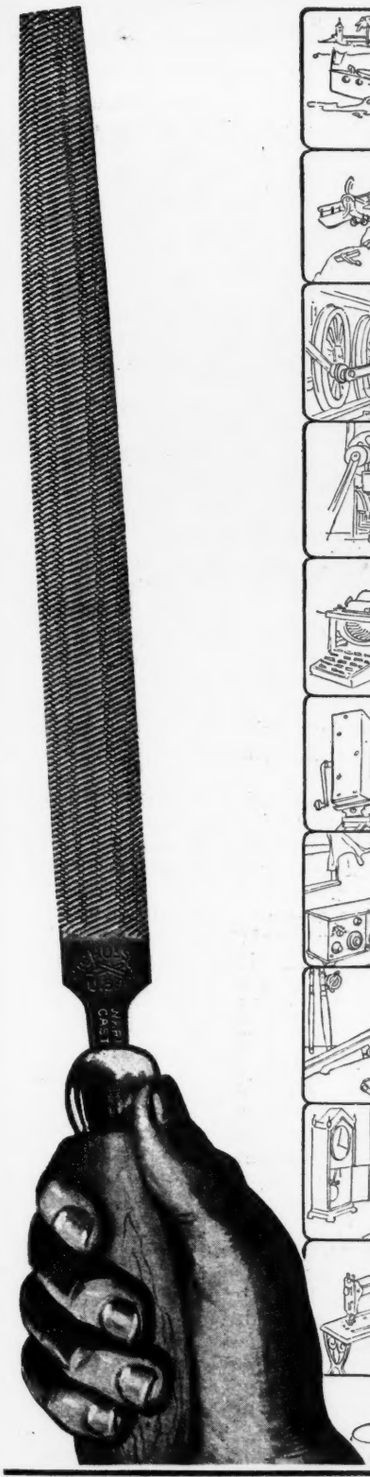
Fig. 6. Supplementary table for machines (above) and two types of angle plates (below)

Fig. 6. Two faces are the rule, although in some cases there is a broad flat-top face with two shorter side faces.

For special work, plates are made with odd angle faces and are, in general, to be preferred to the hinged or swiveling angle plate, as they are more rigid and do not shift under heavy cuts.

Cast iron is the ideal material for angle plates—it is easily machined and holds its shape well. Planing is the usual finishing operation, although small precision plates are ground.

A fine degree of accuracy is obtained on large plates by scraping to a master surface plate and using a master test square for the angular checking. All angle plates should be machined on their edges and these must be square and in line with the faces.



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Good Hardware Dealers carry complete assortments of NICHOLSON Files and Rasps and are competent to help you select those you need.

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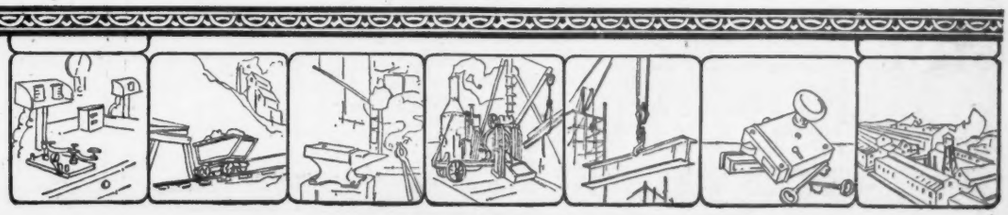

"A Columbia, please"

THAT'S how to ask for a sure-to-be-good dry cell. Name it! Insist on Columbias! There's a snappiness to their power that you'll like. It lasts. You get more battery life for your money. Slow to spend their strength—quick recovery as they rest. Always fresh, because dealers sell them so fast. Most economical battery you can buy. You seldom need new ones. Great for radio dry cell tubes.

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Gas engine ignition
Tractor ignition
Starting Fords
Firing blasts
Motor boat ignition
Heat regulators
Electric clocks
Radio "A"
Running toys

Simple Guide Fixture Saves Time in Tapping Nuts

THIS fixture is useful in shops where contract work is done, especially where nuts have to be manufactured in quantities. Machinists are well acquainted with the procedure of making nut blanks on the screw machine, either automatic or hand; this tool is for tapping the nuts after they are drilled and cut off the bar.

The machine used is either an engine lathe or a small hand-feed screw machine. The tapper tap is as long as possible, up

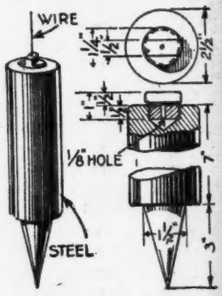
When fed onto the tap, the nuts are kept from turning by hardened guides

to a maximum of 20 in., depending on the size of the hole to be tapped. A tubular piece on the tail center is used for starting the nuts on the tap. Two hardened guides in a guide channel are regulated with adjusting screws to fit the distance across flats of the nuts.

It is apparent that by restraining the nuts from turning and by rotating the tap, the nuts are fed over the tap one by one as fast as they are entered at the point. They gradually run out of the shank of the tap, which is slightly smaller than the root diameter of the tap, and when the tap becomes full, it is removed from the chuck and the loose nuts are dropped off the end of the shank.—W. B. B.

Making a Heavy Plumb-Bob

FOR plumbing elevator shafts, walls, and all outside work that has to be done in windy weather, a heavy plumb-bob is essential. One can be made from a 10-in. length of 2½-in. cold-rolled steel shaft, as shown. It weighs, when finished, about 10 lbs.



Details of the bob

After the bob has been turned to the dimensions indicated, it is placed in a chuck and drilled and tapped for the plug. It is centered again and a hole is drilled through the plug for the plumb-line, which should be wire instead of cord.—E. M. QUIMBY.

COMING SHOP FEATURES

WHAT the Machinist Should Know about Punches and Dies, Making the Most of a Lathe, Saving the Cutting Edge on Planer Tools, How to Build a Small Turret Attachment for a Lathe, and Unusual Uses for a Drill Press.

Tycos Temperature Control

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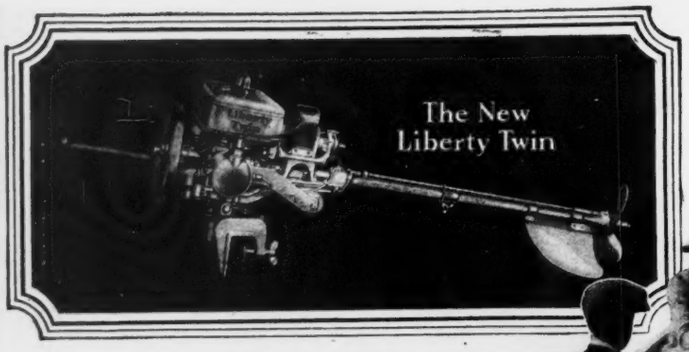

Beautifully finished with nickle trimmings. A motor you will be proud to own.

No Other Rowboat Motor Combines all these Features!

BOSCH Magneto—Zenith Carburetor—twin cylinders—no vibration—light weight—direct drive—lots of speed! A motor that no other *can* follow—that drives your boat where'er 'twill float—through weeds, shallows and over hidden obstructions—the only motor that gives you 100% use of your boat! The

CAILLE DETROIT LIBERTY TWIN

has been tested by thousands of users over a period of four years and has proven its superiority over all vertical and so-called "tilting" motors. Our challenge to other builders to follow us through weeds, shallows and over sunken obstructions has never been accepted and still stands.

Bosch Magneto

The world's standard ignition system. Magneto is mounted on a rocking cradle, specially designed by Caille and Bosch engineers, and gives a uniform hot spark at any speed. Backed by 2,100 Bosch Stations for quick service if needed.

Zenith Carburetor

A "Little Brother" of the carburetor used on every Liberty Aeroplane Motor built. No troublesome "needle valves"—the right gas mixture positively assured. No adjustment required.

Motorcycle Control

The entire control is in the tiller handle—the hand that steers controls the speed. A twist of the wrist times the hot, Bosch spark. Push button at end of steering handle stops the motor.

Easily Carried

The Caille Liberty Twin is so light it can be easily carried. Telescoping shaft can be quickly detached. Motor comes in special chest having handles for convenient carrying.

Send to Nearest Branch Office for Literature

Ask for Measuring Chart to assist you in figuring value of all outboard motors—free.

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The Single Cylinder LIBERTY
The Motor That Proved the Direct Drive Principle $85
complete with battery ignition. Same principle as Liberty Twin but very moderately priced.

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Gentlemen:
Please send me full particulars about the new Caille Liberty Twin.

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Some Secrets of Hardening

(*Continued from page 86*)

ply that will have a 12-ft. head—a tank on the floor above is what I used. I bring a 4-in. pipe straight down over the die and couple directly on the end of this a length of tin or galvanized iron pipe. The tin pipe can be shaped roughly to the outline of the engraving on the die and arranged to stand about 4 in. above the die face. Have a clapper valve hinged inside the tank to cover the 4-in. opening and arranged to be opened by means of a cord within easy reach of the operator, so that he can open the valve wide instantly.

Now heat the die slowly and carefully to the desired heat, say cherry red. Be careful not to disturb the bone black on the engraving, but move it on the corners so as to see the color of the die. When hot, place the die carefully on the pipes in the box and against the guide pins. See that the pipe is in position directly over the engraving. Remove the iron band without disturbing the bone black more than is necessary, pull the valve quickly, and hold it open until the die is cold. The water will carry the bone black away instantly.

Reduces Chances of Cracking

It will be found to be hard only under the impact of the water, and the balance can be drilled and tapped to hold gages, thus avoiding the risk of cracking the corners if the holes are drilled beforehand.

With a little practice, I have been able to harden to a distance outside the figure of about ¾ in. The balance is hardened slightly, but can easily be drilled and tapped for the gage screws. If the die does not lie steadily on the drop-hammer base, it can be planed on the bottom.

This may seem a considerable to-do to harden a die, but the outfit is suitable for many kinds of work. The only change is in the position of the guide pins and the shape of the tin bottom section of the pipe, which is formed easily to suit the outline of the engraving. I have hardened a good many drop-hammer dies, and had no loss from cracking by this process.

By making a suitable cooling ring, it is quite possible to harden a grooved pulley, or similar article, all the way around in the bottom of the groove and leave the balance comparatively soft.

The die does not need to be drawn unless there are very delicate parts, which would be unusual for drop-hammer work.

WHEN Mr. Horton uses the term "cherry red" he is not implying, of course, that the now more or less obsolete method of judging heat by color should be followed, except in the absence of other means. Naturally, the heating by color is responsible for many of the failures of which he writes, as there may be a variation in from 200 to 400 degrees in what different mechanics would call a cherry red. In order to place the emphasis solely upon his own interesting experiences in hardening, Mr. Horton has ignored side issues and it is to be taken for granted that electric pyrometers or temperature cones will be used when available in the heating of expensive tools and dies.

Selected Wood Scientifically Shaped Produces Faithful Tones

LISTEN! The Sextette from Lucia! The living voices of the great artists—as if floating in through the window on wings of magic!

MUSIC MASTER, Radio's musical instrument, catches the softest tones, the most delicate shadings, the personality of each artist's voice—and illusion of their presence in your home is perfect.

The wood amplifying bell of MUSIC MASTER eliminates blast, rattle and thin nasal tones and substitutes in their stead full, clear, resonant tones—faithful and lifelike, a delight to the ear. No other material but *wood* does that satisfactorily.

There is a scientific reason for the material, size and design of every part of MUSIC MASTER—developed and perfected by men who have spent more than a score of years in the study of sound reproduction.

Go to your dealer and let MUSIC MASTER speak for itself; or, better still, have one sent to your home to test and prove on your own set.

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Makers and Distributors of High-Grade Radio Apparatus
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14-inch Model, for the Home - - - - - - - $30
21-inch Model, for Concerts and Dancing - $35

Connect in place of headphones.
No batteries required.
No adjustments.

Music Master
RADIO REPRODUCER

Each Serves Its Community

In Frazer, Colorado, a log cabin of three rooms shelters a telephone exchange that connects with the mountain homes of cowmen, miners, homesteaders and tie-cutters. In the heart of New York City a new building of twenty-nine stories is to become the home of several metropolitan central offices serving some 120,000 telephones. This building will contain, as well, offices for executives and for engineering, commercial, plant and accounting forces, providing space for over 7000 telephone workers.

Each of these buildings helps to render adequate and economical telephone service in its own community. They stand at the extremes in size, equipment and personnel. Yet they both indicate the nation-wide need for adequate housing of the activities of the Bell System; and they illustrate the varied ways in which that need is being met. One of the largest single items of plant investment of the Bell System is real estate, comprising nearly 1700 buildings acquired, with their sites, at a cost of $180,000,000.

It is continuously the aim of the Bell System to construct and so to situate each new building—whether executive office, central office, storehouse or garage—so that it shall serve its community with the utmost efficiency and economy, and remain a sound investment throughout its period of life.

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SOLDERALL BLOW TORCH
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indispensable in the Home, Garage and to the Electrician. For soldering Radio, House Wiring, Jewelry, Ignition, Kitchen Utensils, etc.

SOLDERALL CO. Dept. A Newark, N.J.

Cheaply Made Valve Grinder for the Small Garage

By Frank N. Coakley

UNTIL his work increases sufficiently to warrant the purchase of an expensive valve-grinding machine, the owner of a small garage can make at low cost a very satisfactory machine of his own, as illustrated.

A small hand-operated emery wheel is necessary. A good one can be obtained for about $4.50, preferably one with a 5-in. wheel, although a smaller wheel will do. A ¼-in. thick piece of steel plate 7½ in. wide and 11½ in. long serves as the base. This is cut, as indicated in Fig. 1, across one corner at an angle of 45 degrees. Two cap screws or bolts are used to fasten

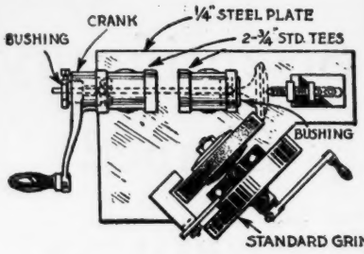


Fig 1. Top view of the valve-grinding machine that utilizes a small tool grinder

the grinder in place. It is best to slot the holes, so that the grinder can be moved forward as the wheel wears down.

The height from the base plate to the center of the valve support is governed by the height of the grinder to the center of the wheel. The distances must correspond.

Two ¾-in. tees and 2 short pieces of ¾-in. pipe serve as bearings and uprights. A crank is used to rotate the valve. The threads in the outer ends of the tees are machined away.

The end of the crank hub is turned down to fit the pipe-tee and a groove machined in it to receive the end of a ¼-in. setscrew (Fig. 2). The face side of the hub is tapped to receive a bushing. Two bushings in all are required and they should be bored a tight fit for the valve stem. For each size of valve rods handled, a separate pair of bushings will be required.

For feeding the valve to the wheel, a thumbscrew with fine threads is used. This is held in position by a bracket and

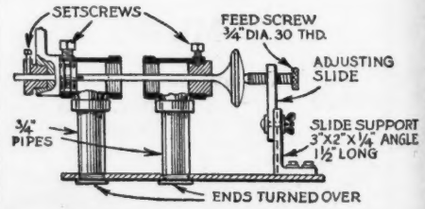


Fig. 2. The method of holding the valve stem, which is revolved by a hand crank

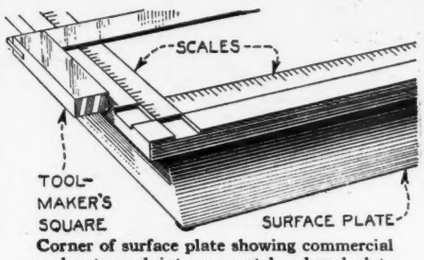
an adjustable slide. The bracket is made from a 1½-in. length of 3 by 2 by ¼ in. angle iron grooved on the face to allow the slide to be moved down when a valve is to be taken out or put in the machine.

An advantage of this rig is that the grinder can be used for tool grinding when not required for grinding valves.

Inserted Scales Give Added Usefulness to Surface Plate

A METHOD of improving the most important tool in the shop—the surface plate—is shown in the accompanying illustration. The word "important" is used advisedly, as all accuracy in dimensions must start from the surface plate.

A toolmaker's square is used against the left-hand edge of the conventional surface plate. If this edge is not finished, it should be. Then regular commercial



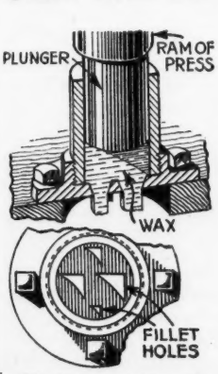
Corner of surface plate showing commercial scales tapped into accurately planed slots

scales, with graduations suitable for the use to which the plate is to be put, are set into these plates, about ½ in. from the left and lower edges, as denoted. Plane clean, square-cornered grooves just wide enough to be a good tapping fit for the scales, which are driven into place with a block of hard wood and a hammer.

The advantage of this arrangement is that a piece of work can be clamped on the surface plate and measurements transferred to it from two sides direct from the scale. If very fine tool work is being done, a Vernier slide may also be used. With the regular surface plate, measurements for comparison can be made only vertically or in one direction, but with a plate having scale insets, measurements and layouts may be made in three directions or three planes.—W. BURR BENNETT.

Wax Fillets for Pattern Work Made in Simple Press

READYMADE wax fillets for filling the square corners in patterns can be made in quantity by the use of the press illustrated. A plunger operating in a cylinder forces the warm wax through orifices made in the bottom plate. These openings are the exact sizes of the fillets commonly required and are beveled upward toward the inside, so that the wax can flow freely.



Plunger presses soft wax through die plate

A good wax mixture to use consists of 1 pt. linseed oil, 4 lbs. beeswax, 4 lbs. whiting and 1 lb. rosin. It becomes hard when cold, can be glued to the patterns, and is practically unaffected by contact with moist sand.

Prepared fillets of this type save time over the familiar wax taper method, which requires more handwork.—G. A. L.

10 Shaves **FREE** *See Coupon*

Don't Buy Yet

First prove our claims—Make this ten-shave test

By V. K. Cassady, Chief Chemist

GENTLEMEN:

The claims we make on Palmolive Shaving Cream seem hard to believe, we know.

So we never ask men to buy. We never state its price—never say that druggists sell it. All we urge or offer is a ten-shave test at our cost. We ask you to prove our claims in fairness to us both.

It is better than we expected

Palmolive Shaving Cream surprised us as much as it will you. We never dreamed that shaving creams could be so improved.

But we are masters of soap making. We had devoted our lifetimes to soap study. We had done some great things. In Palmolive Soap we had created the leading toilet soap of the world. We learned what men wanted in a Shaving Cream. We worked 18 months to meet those desires to the limit. We made up and tested 130 formulas before we satisfied ourselves.

Men were amazed

We did better than we dreamed. This Shaving Cream, when perfected, became an instant sensation. Millions asked us for the 10-shave tube, and they flocked to this Cream when they tried it.

They told others about it. They wrote us letters—tens of thousands—to thank us for making it.

Thus Palmolive Shaving Cream attained the pedestal place, without ever a man being asked to buy.

Now we ask you to make this test, if you have not. Do it as a courtesy to us. Do it in fairness to yourself. Cut out the coupon now.

HOW IT EXCELS

1—Multiplies itself in lather 250 times.
2—Softens the beard in one minute.
3—Maintains its creamy fullness for ten minutes on the face.
4—Extra-strong bubbles support the hairs for cutting.
5—The palm and olive oil blend bring fine after effects.

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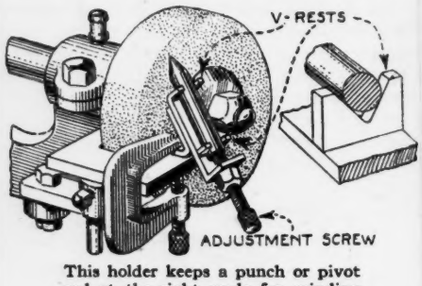
Simple V-Rest Fixture Aids in Grinding Center Punches

TO GRIND center punches and pivot rods accurately is a trying job for almost any mechanic. For precision work even a minute deviation from the true center is not permissible. This makes it desirable to use some other method than



This holder keeps a punch or pivot rod at the right angle for grinding

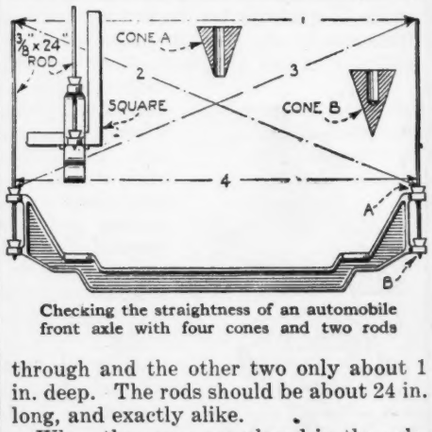
trying to center the punch or rod in a universal chuck.

An accurate job can be done by using a simple V-rest in conjunction with an ordinary grinder. The V-rest, made from flat steel, as shown, is fastened at an angle of 30 degrees with the face of the grinder. An adjustment screw at the lower end moves the work toward and away from the wheel. The point of this screw should bear against the center of the base of the tool or rod and this base must be perpendicular to the axis of the tool.

If the adjustment is properly made and the tool carefully turned in the rests, the point will be formed in the exact center of the punch.

Cones and Rods Form Useful Gage for Testing Axles

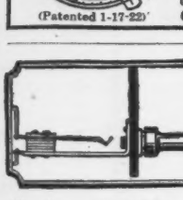
FOR straightening automobile front axles, an accurate gage can be made quickly from four cones and two rods. The cones, which are turned and drilled as shown to receive the rods, should be about 2 in. in diameter at the base and 2¼ in. long, so that they will fit the average axle. Two of the cones are drilled completely



Checking the straightness of an automobile front axle with four cones and two rods

through and the other two only about 1 in. deep. The rods should be about 24 in. long, and exactly alike.

When the cones are placed in the axle, their axes conform with those of the holes. Therefore, when the rods are placed in position, they should be parallel if the axle is straight. Any error can be detected immediately by placing a square on the spring chair as indicated, and the parallelism of the rods can be checked by comparing the distances marked 1, 4, 2, and 3.
—O. W. MIELENZ, Philadelphia, Pa.



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is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Leather Case 50c extra. Catalogue Free.

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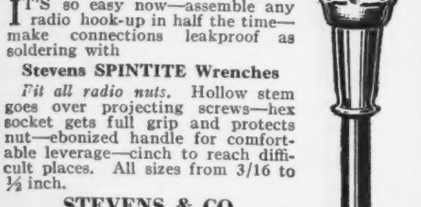

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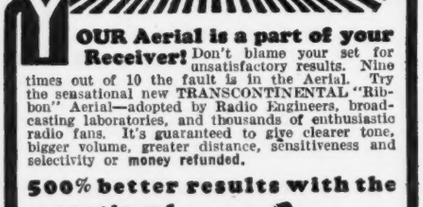

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75 ft., $2.25
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Complete, ready for use with soldered snap hooks to fasten on to insulators.

weather proofed! to resist corrosion. Based on scientific principle that broad surface increases receptivity and amplifies the tone. Equally satisfactory with tube or crystal sets. "Twist it!" says FORREST, the famous radio expert. "2 twists per 50 feet catches waves in all directions."

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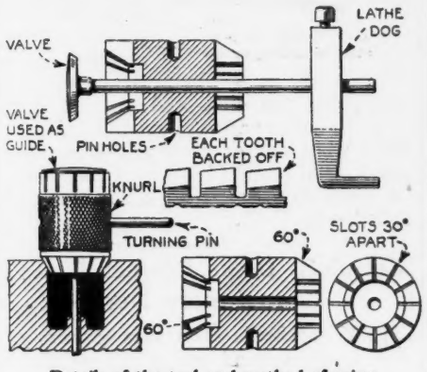
One-Piece Tool for Refitting Engine Valves

RESEATING tools for engine valves frequently are more or less complicated. This simple tool, however, can be made from one piece with a lathe and a hacksaw or any power-driven saw.

The tool is of any grade steel that can be tempered. Its external diameter is somewhat larger than the valve. The piece is chucked in a lathe, the center is bored to fit the valve stem exactly, and the ends are cupped slightly to facilitate cutting the flutes. The ends are beveled, one externally and the other internally,



Details of the tool and method of using it for facing valves and valve seats

as indicated, at an angle of 60 degrees for standard use or otherwise to suit any special valve. The surface is knurled for the purposes of turning by hand and drilled with four holes to take a pin for use in heavy cutting.

Each end of the tool is slotted with with wide slots about 30 degrees apart made by using two hacksaw blades in a holder. With a file these flutes are backed off to provide the cutting edges, which completes the tool up to the point of tempering.

To face a valve with the tool, the stem is passed through the hole and a clamp or lathe dog is placed on the stem to act as a handle for turning it. In cutting the seat in the block, the valve stem guides the tool.—G. A. LUERS.

Non-Slip Hammer Handle

THE ordinary hammer handle becomes slippery when used on an oily or greasy job, but a handle prepared as shown will give good results.

To shape the handle in this way, first cover the inside of your right hand with a thin coat of Prussian blue. Grip the handle and strike several blows with the hammer. This will leave the prints of the fingers and thumb on the handle. With a knife and a round file cut away these marks, testing the handle from time to time.—JOHN AURES, Buffalo, N. Y.

DRAWINGS and blueprints may be varnished before sending them out into the shop in the following manner: Dissolve gelatin in water and coat the drawing with this by means of a soft brush. After this coating has thoroughly dried, give the drawing a coat of clear varnish.

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PORTABLE ELECTRIC DRILL
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$28,
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Grinding Outfit.—Consists of stand which can be fastened to bench top, arbor with clamp washers and nut, and grinding wheel.
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Bench Drilling Stand. The drill can be inserted or detached quickly by means of handle clamp.
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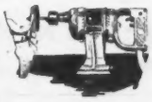
1 Does a thousand and one drilling jobs around the car house and shop

2 For drilling radio panels and accurate drilling on the bench.



3 Does all sorts of light grinding at home or in the shop

The Drill of a Thousand Uses

A few years ago only practical mechanics ever thought of having a portable electric drill in their kit—but now that the prices have become so low they are one of the most important items in the home tool kit.

There are so many things they can be used for besides just drilling, although, when you stop to think about it good mechanics will use a drill more than they will a hammer—not only for bolts, but lead holes for screws and for wire nails in hardwood, holes for dowels, cotters, etc.

But when you can drill radio panels, holes in glass, polish silver and buff polished parts, and sharpen knives, grind down a screwdriver to fit a small slot, or sharpen an ax with the same tool, you realize the usefulness above such common tools as a hammer and saw.

By using the electric drill in this way you give yourself an extra hand, because one hand in not being used to turn a crank.

Needless to say the electric tool means a quicker better job with less exertion.

There is one thing about anyone one of us that has a mechanical leaning—we instinctively know that it doesn't pay to buy anything but good tools. The Black & Decker Mfg. Co. has for years manufactured fine electric tools and the practical mechanic, if you ask him, about electric drills will almost automatically say BLACK & DECKER.

Thousands of the Quarter-Inchers illustrated above are being used for production work, especially for auto body building, sheet metal work, and automobile repairing.

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—Efficient because after the shave a soothing ingredient in Williams has cooled and soothed your face so that your daily shave is comfortable no matter how heavy or bristly your beard.

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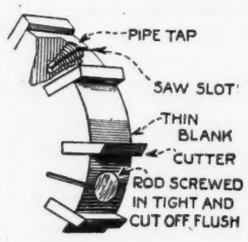
Williams Shaving Cream

Inserted Milling-Machine Cutters Held in Thin Blanks

MILLING-MACHINE cutters sometimes have to be held in blanks that are too thin for the successful use of taper pins or screws and wedges. In such cases the blank may be drilled and tapped, as illustrated, with an ordinary pipe tap. After tapping, the holes are slotted with a hacksaw. A solid rod is threaded with a pipe die, screwed in as tight as possible, expanding the slot, and cut off flush.



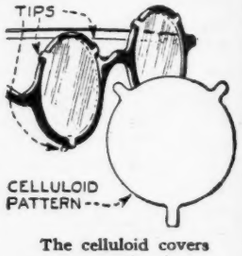
This makes a substantial milling cutter

If the cutters do not have to be changed until worn out or broken, this makes a substantial tool. I have used the method on thin blanks after all other ideas had failed.—E. C. F.

Celluloid Disks Protect Glasses from Emery Dust

ANY mechanic who uses glasses and works around emery wheels knows that fine pieces of emery are apt to stick in the lenses and ruin them. This can be prevented by making two transparent celluloid covers or protectors for the glasses, as illustrated.

These disks are cut from celluloid and two of the three small ears are bent over hook-like, while the third, which is somewhat longer, is shaped to form a small snap catch. This can be done by dipping the celluloid in hot water, bending the ears, holding them in shape, and dipping in ice water.

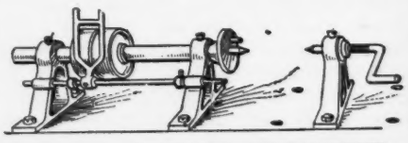


The celluloid covers snap over the glasses

The same idea is useful when sun glasses are needed. No one can wear sun glasses over his regular glasses and feel comfortable, but if a pair of these covers are made from colored celluloid, they can be snapped over ordinary glasses.—E. G. HEADLEY, Parkersburg, W. Va.

Speed Lathe for Rough Use Made from Countershaft

FOR filing and polishing round stock, a lathe made as illustrated from an old countershaft is giving good service. The shaft was cut down to take the tight and loose pulleys only, the cone being discarded. A hanger serves as the tailstock.



Costing little to build, this lathe serves for filing and polishing round stock

$25.00 in PRIZES See top of page 8 of this issue for full details.

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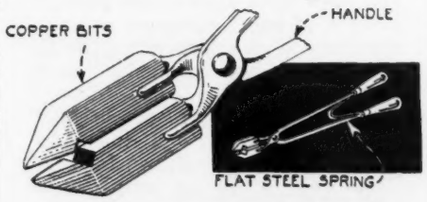
Soldering Tongs Save Time in Making Electrical Splices

THE soldering of splices in electric wires is speeded up by use of the special tong-type soldering copper illustrated.

Unlike the usual taper-pointed copper, which is applied only to one side of the joint, this copper is in two sections, with jointed handles. It is clamped about the spliced wire and heats all sections, so that the solder flows uniformly and quickly into the joint.

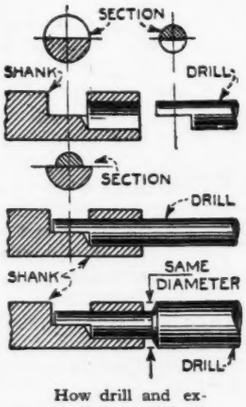


Pressed together over a splice, the double soldering bits quickly form a perfect joint

A small flat spring of flexible steel is attached near the handles to separate the points automatically.—G. L.

Extending Small Drills

TO INCREASE the length of small drills is frequently necessary. This can be done by fitting an extension piece to the shank of the drill as illustrated. A hole the same diameter as the drill is drilled in one end of the piece. Beyond this drill hole the stock is cut down to the center line for a length of about one diameter. One half of the end of the drill is cut away also for a similar distance. The drill then can be driven firmly into the extension.



How drill and extension are joined

If the extension diameter must not exceed the drill diameter, it will be necessary to turn down the shank of the drill to about three-fourths of its original diameter before fitting it to the extension.—W. G. HOLMES.

Leather Wrench Handle

THE round wooden handle found on some adjustable wrenches sometimes cracks through accident or misuse. It can be replaced with washers made from scrap leather or old belting, as depicted. This makes a good repair and also gives a more comfortable grip, as the leather conforms more or less to the shape of the hand.—E. M. QUIMBY.

AN ARTICLE on unusual uses for a drill press is scheduled for early publication.

Complete Dependability Extra Long Life

Years after the ordinary truck would be worn out, GMC can still provide dependable, profitable service. As a matter of fact, it is impossible to estimate when GMC will wear out—it lasts indefinitely.

This extraordinarily long life of GMC results directly from important features of GMC construction. In the first place, GMC trucks are built oversize in every part of both engine and chassis.

Secondly, all wearing parts of GMC—engine bearings, cylinder walls, valve lifter assemblies and chassis bearings—are fitted with removable bushings or bearings that are quickly and easily replacable.

And this unusual dependability and extra long life provided by GMC has a meaning for GMC dealers. Not only is it a deciding selling argument but also it assures owner satisfaction and constantly increasing good will.

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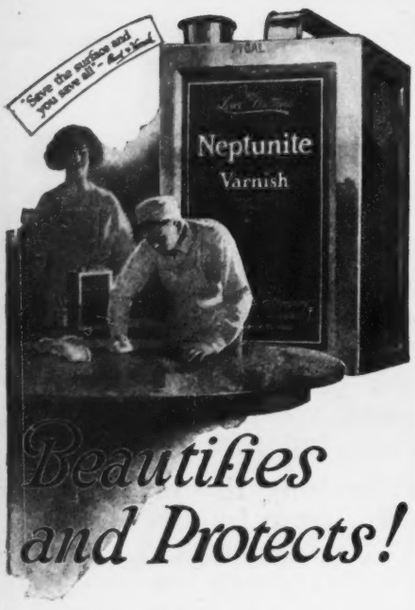

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The well-informed painters and craftsman furniture finishers know that with Neptunite they can produce a clear, smooth, mirror-like finish—a finish which enhances the natural beauty of the wood graining—a finish that is heat-proof and water-proof, never turns white, won't even scratch white.

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Making a "Turned" Spiral Pedestal

By Gladstone Califf
Superintendent of Schools, Richland, Ia.

SPIRALLY turned pedestals or legs are considered by 99 out of 100 home workers as being beyond the skill of any amateur mechanic without a lathe. Actually, however, they can be made with a few hand tools and some care.

It is surprising indeed what can be made in the home workshop. Figure 1 shows a pedestal turned on a lathe and Fig. 2 is one made entirely by hand with tools that every woodworker possesses. These represent a very old type of ornamentation that recently is enjoying renewed popularity. Generally speaking, it resembles a piece of rope twisted around a wooden rod.

Fig. 1. A lathe-turned flower stand

Fig. 2. One made with hand tools

To make a pedestal like Fig. 2, use a large old table leg or a "four by four." If the latter is to be used, find the center of each end and draw circles to represent the top and bottom, the top being smaller. The piece is rounded by first planing it octagonal. This is done by gaging two lines on each surface with the gage set to equal half the diagonal across the square end of the block. Then, judging with the eye, plane the 8 edges until there are 16 equal sides. Plane again until there are 32 sides. Then scrape the piece and round it with sandpaper. The tapering is done with a spokeshave, your eye being the only guide.

Fig. 3. Marking the depth of the strands with a back-saw

Fig. 4. Rounding the twisted strands evenly with a chisel

The blank is held for working, as in Fig. 5.

For a 4-strand twist, as in Fig. 6, divide the circles at each end into 4 equal parts. Connect the points with straight lines and draw lines around the piece at any number of equal distances apart. The closer the lines are together, the tighter will be the twist. This division is made with dividers and the lines are drawn by wrapping a length of twine around the piece to serve as a guide for the pencil.

It is necessary to use the cord again to connect the various intersections in laying out the strands. This is done by selecting a point at one end and working from it, connecting the intersections diagonally, one after another, as indicated in Fig. 6.

You are now ready to cut the strands. Saw a kerf or slot about $\frac{1}{8}$ in. deep on each spiral mark going around the piece, as photographed in Fig. 3. Then use a chisel and start cutting back about $\frac{1}{8}$ in. from the lines, cutting each line from both sides (Fig. 4). You will have to use your own judgment in the depth of cutting; it may be necessary to saw a little deeper.

A wood rasp can be used in completing the strands and sandpaper for finishing.

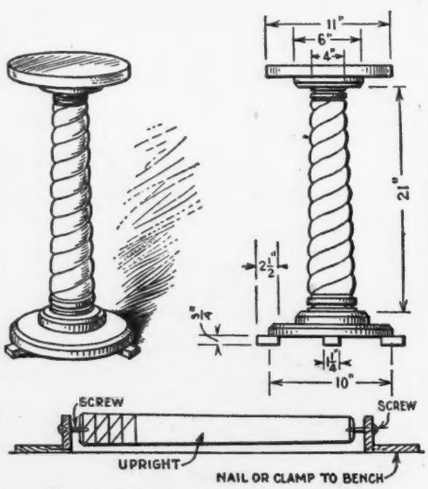

Fig. 5. Details of the stand shown in Fig. 2 above, and the method of holding the work

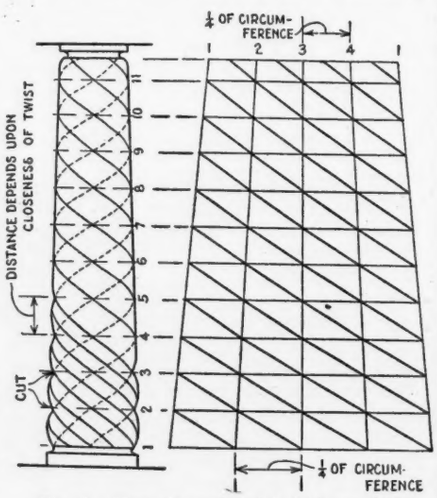

Fig. 6. How the pedestal is laid out (at left), and diagram of the method (at right)

A Convenient Bench Is Essential in Any Home Workshop

TO BUILD an ideal home workshop bench is neither difficult nor expensive if the details of POPULAR SCIENCE MONTHLY'S Blueprint No. 15 (listed below) are followed. That print was used

From POPULAR SCIENCE MONTHLY'S Blueprint No. 15; made for less than $10

by E. Crass, of Paducah, Ky., in building the bench illustrated, and he writes as follows:

The cost of lumber did not exceed $10 and if cheaper lumber had been used, the cost might have been as low as $5 or $6. The top and framework are made of No. 1 seasoned oak at 10 cents a foot, or about $7 altogether. The drawer fronts are No. 1 dressed ⅞-in. pine. The back, sides, and bottoms of the drawers are pine obtained from boxes or crating. The back and bottom of the bench and the linings for the end lockers are thin three-ply veneer, from a phonograph crate procured at a musical instrument store.

After the bench had been built, I gave it a good rubbing with fine sandpaper and applied filler and then two coats of light floor varnish, which gave it a nice finish.

I am highly pleased with my workbench and will say to any one who is interested that it is time, work, and money well spent and serves its purpose in every respect.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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31.	Priscilla Sewing Cabinets	25c	☐
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$50
buys this Corona complete with carrying case
Easy terms arranged if you desire

You can own this splendid Corona typewriter

IT'S a beauty, as you can see—right up to the minute in every feature—just the kind of typewriter you have always longed to own!

With this machine you can type your own letters, orders, reports, or bills. You can write manuscripts of stories or articles for magazines.

The key to success

Successful people everywhere use Coronas because they have learned the value of time—and because they know that the *appearance* of their work may make all the difference between success and failure.

An hour spent with Corona each evening has put many a man on the road to bigger income.

Fine for office use

Business men are learning that Corona is not only more convenient than the heavy type of office typewriter—but *stands the strain of office work much better.*

One stenographer writes: "I use my Corona constantly for all kinds of office work and only twice in four years has it needed the slightest repair!"

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Corona is the pioneer, portable typewriter with an 18 year record of Proved Durability.

Corona has automatic ribbon reverse, self-spacing carriage return, two color ribbon, back spacer, wide 10 in. carriage and many other improvements

Corona writes VISIBLY—there is NOTHING between your eye and the paper.

Corona will make 12 to 14 good carbon copies.

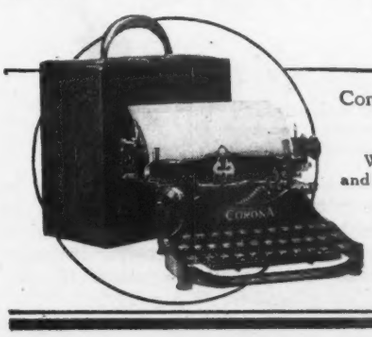
Corona is one of the best stencil cutting typewriters made.

Corona fills in letters, fills out card records and addresses envelopes, more accurately, quickly and neatly than the average "heavy typewriter."

You can have this Corona TODAY!

You need not wait another minute. Just look up "Corona" in your phone book, telephone the Corona dealer and he will send this Corona to you for free examination. If you decide to keep it, pay only $50 cash, *or you can buy on easy monthly terms.*

If Corona is not listed in your phone book, mail this coupon *now* while it is fresh in your mind. Don't delay. Success is built on decisive action.



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Without any obligation, send me complete Corona literature and the address of the nearest Corona dealer.

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It Holds

THAT'S what this famous vise does and that's what you want it to do if you are a man who enjoys making things.

We offer designs that will satisfy your requirements.

For the RADIO CONSTRUCTOR this will hold your materials while you are winding coils, drilling panels, soldering, adjusting, etc.

For the AUTOMOBILE OWNER you need this vise when you are grinding, or filing, or sawing, or making any of those little repairs so often necessary.

For the HOME OWNER this is needed when you are making the hundred and one things that you are building or repairing for the house.

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have enjoyed a reputation for superiority over a period of 68 years.

The PRENTISS is the vise you need.

Our "Bull Dog" vise pictured here is a great favorite. For all-round usefulness no other vise compares with it.

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Gentlemen: Please send me your latest booklet describing PRENTISS VISES and including prices.

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How to Build Ornamental Flower Boxes and Brackets

FLOWER boxes are becoming more and more a distinct architectural feature for the exterior of houses. They can be built with very little difficulty or expense and when properly painted add much to the appearance of the building. The boxes usually are set on brackets and placed below the first-floor windows or used on the porch or alongside the steps.

The first box illustrated in Fig. 1 is quite plain. It is simply nailed together

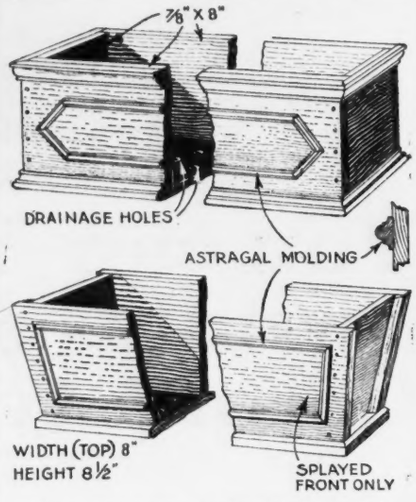


Fig 1. Two types of easily made boxes that permit many individual variations in design

and a molding is mitered around the top and bottom on the front and ends. The paneled effect can be added by nailing on an astragal molding or even a simple strip of lath. A great variety of panel designs may be made in this way.

The second box has splayed front and ends; the back is vertical. The sides and bottom project over the ends to relieve

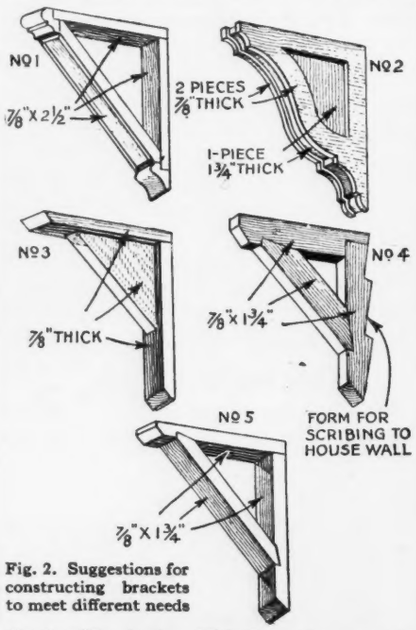


Fig. 2. Suggestions for constructing brackets to meet different needs

the boxlike look. This box also may be made plain or paneled. It should be remembered that holes must be bored in the bottom of all flower boxes for drainage.

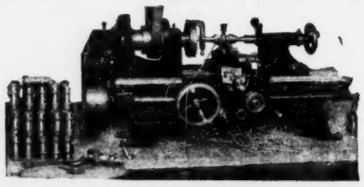
These boxes may be made of any

(*Continued on page 111*)

Send for this Bulletin it is FREE POSTPAID

Prices of Bench Lathes

SIZE	Quick Change	Standard Change
9" x 3'	$231.00	$201.00
11" x 4'	278.00	238.00
13" x 5'	344.00	294.00



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Tool No. 12 has a fine knife blade and two screwdriver blades. Tool No. 11 has three screwdriver blades. The handle of both tools is blued to prevent rust. A handy tool for mechanics, hunters, boy scouts and for household use.

Send $2.25 for tool No. 12 or $1.80 for tool No. 11. Your personal check accepted. Money refunded if not satisfied.

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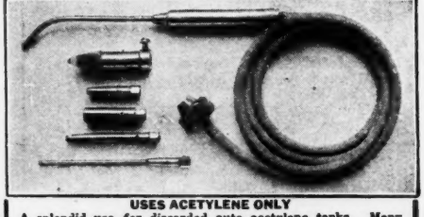
ADD $5.00 a DAY to YOUR PROFITS with a TORIT ACETYLENE TORCH No. 13

For radiator repairing, general soldering, light brazing, heating, battery repairing, etc. Produces instant hot flame, works rapidly. Furnished with 4 different tips and soldering copper, enabling you to do a wider range of work.



USES ACETYLENE ONLY

A splendid use for discarded auto acetylene tanks. Many owners make the Torit No. 13 pay for itself in a single day. Torch with 4 different tips, soldering copper, 6 ft. tubing and connection for auto acetylene tank. **$7.50**

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OUR SPECIALS: Set of 8 electrical fixtures with glassware, completely wired, ready to connect, **$24.50.**

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FREE CATALOG

Colorful Lanterns Made of Cardboard and Paper

ORIGINAL lamps or lanterns that will rival the colorful and striking creations of professional decorators can be constructed in any home workshop with the simplest tools and materials.

The lantern consists of a cardboard frame with cut-out openings filled with oiled or "parchment" paper. The design,

Although inexpensive and easily made, this lantern has a rich and costly appearance

which may be copied from advertisements, or developed from lamps seen in stores and elsewhere, is laid out in pencil on a large sheet of cardboard, cut out with a knife, bent to a square, octagonal or round shape, as the case may be, and fastened with glue or sewed. The bottom is made separately. It may be covered with gold or silver paper or coated with bronze or aluminum paint. Semitransparent oiled paper is then placed in the bottom and fixed against the side openings. The lantern conceals an ordinary electric droplight and is suspended by chains or heavy silk cords.—H. S. T.

Methods for making parchment lampshade paper were described in an article, "How to Color Parchment Shades," on page 90 of our August, 1923, issue.

Flower Boxes and Brackets

(*Continued from page 110*)

reasonable length, but if more than 4 ft., at least three brackets should be used to support them. Five of the simpler flower-box wall brackets are shown in Fig. 2. In No. 1 the molding gives no strength to the bracket, but it takes the place of scrollwork. All the parts must be nailed securely together in this, as in the other designs, so that the brackets will sustain a heavy weight. This bracket may be left open as indicated or a panel may be nailed in the triangular opening.

Number 2 is built up of three or four pieces. The two outside pieces are cut as shown, but the core, of one or two thicknesses, is cut only on the front edge, and is about ⅜ in. narrower than the outside pieces. This gives a paneled effect when all the parts are nailed together.

Number 3 is the simplest of all, but very strong; No. 4 is good construction for scribing to siding or shingles and No. 5 is easily nailed or bolted to the wall. —A. E. ELLING.

YOUR receiving set can be no better, in delivered results, than the loud speaker you use with it. Give your set, and yourself, the benefit of the best.

THE THOMPSON MAGNAPHONE is a radio reproducer that brings out the best that is in your set—because it is specifically designed and built for that particular purpose, not merely adapted from other purposes.

All that you've been seeking, and haven't found elsewhere in loud speakers, is yours with the MAGNAPHONE—the volume, the tone quality, the control, the natural reproduction of the original performance unmarred by mechanical distortion. You'll notice the difference instantly, when you plug in a MAGNAPHONE.

Here are a few features that make the MAGNAPHONE different, and better:—cone-shaped bakelite diaphragm vibrating equally over its whole area; two-to-one driving armature, reducing the permissible air gap 50%; laminated magnetic pole pieces and generously large magnet; combined in a structure forming a loud-speaker giving results so incomparably superior that the MAGNAPHONE is the instant choice of those who demand the best.

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Ask your dealer to demonstrate the MAGNAPHONE—compare it with any other loud speaker, from any standpoint—and you'll admit that Thompson's 14 years' experience in radio manufacture has produced the radio reproducer that satisfies your every requirement.

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A 5-tube balanced receiving set as supreme in its class as the MAGNAPHONE is among loud speakers. To hear it is to recognize its superiority—yet the price is only $150.00.

Licensed under Hazeltine patent No. 1,450,080 and pending application Ser. No. 433,729. Other patents pending

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End Hack Saw Blade Breakage

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That's why they out-cut and outlast other blades. Prove it for yourself. Send us ten cents and tell us what metal you cut and we'll send a sample blade. You'll say it's the best you ever used.

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When you need a hand saw, circular saw, band saw, pruning saw, metal-cutting machine, or *any* saw for cutting wood or metal—there's an Atkins saw that will save time, money and labor. Write for our free booklet on any saw you need.

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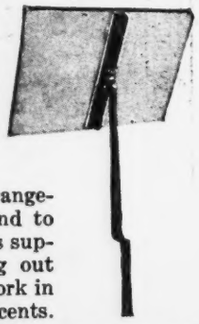
E. C. ATKINS & CO., Inc.
Dept. D-20, INDIANAPOLIS, IND.
Makers of "Silver Steel" Saws and Tools

Old Radius Rod Forms Unique Mounting for Drawing-Board

IN MY home workshop I have found by experience that a drawing board is needed as often as any of my tools. In trying to construct one of my own from odds and ends, I built the adjustable stand illustrated, which is perhaps the best thing, considering the price, I have in my outfit.

It was built from an old radius rod or "wishbone" from a Ford auto. One prong was cut off as close as possible and the raw edges were dressed with a file. Next it was taken to a blacksmith shop and flattened out and bent as shown. The angle at the ball end must face the same way as the drawing board is to face.



Through the flat end were drilled two ⅜-in. holes, and slots were cut above these to engage the supporting screws. This arrangement allows the stand to be removed from its support without taking out the screws. The work in this case cost 15 cents.

The drawing-board stand in use and rear view showing adjustable radius rod support

Two cones and two 5/16 by 1½ in. bolts and nuts, all standard Ford parts, also were needed, as well as a piece of light angle iron, such as is used for railings in iron beds. The latter was cut to the width of the drawing-board and screwed to the back of the board after a semicircular notch had been cut in the center of the angle iron so as to clear the cone. Then, using the cone as templet, two holes were marked and drilled for use in bolting the standard and board together. The bolts were tightened up so that the board would stay in any position.

Anyone should be able to make one of these stands, exclusive of the drawing-board, for not more than 75 cents. An old radius rod can be obtained for nothing at almost any Ford repair shop. The two cones, even if purchased new, cost only 30 cents; the angle iron, extra light, should not be more than 25 cents.—PEARL CORK.

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In your home, stops leaks in water, gas and steam pipes, tanks and pots, roofs, etc.

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Wears like Iron
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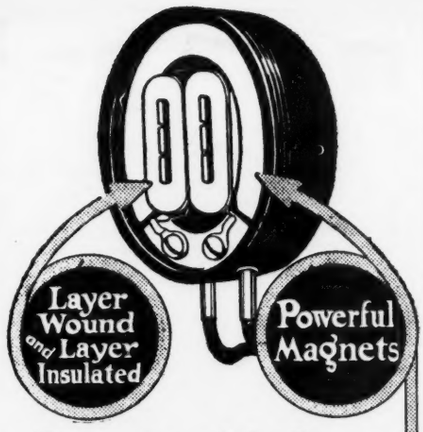

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Ornamental Papers for Craft Work Made with Water Colors

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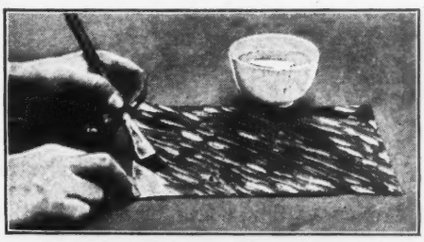
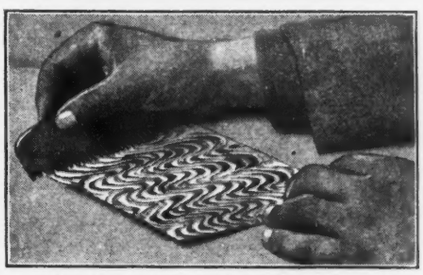
Dissolve half a teaspoonful of starch in half a glass of cold water. Pour half a pint of boiling water into a container and stir in the starch until the liquid is clear.

To tint this starch when cold, water colors are used. Those intended for photographic prints are best, as they are





Blending colors with a brush and using a cardboard comb for a grained effect

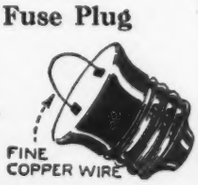
bright and transparent, but artist's ordinary moist water colors will do very well. The starch is placed in smaller vessels and each container is colored with one of the tints to be used.

With a comparatively stiff brush, the color is brushed evenly on the paper to be decorated. Do not brush it out too thin. An interesting pattern or design can then be formed by drawing a few heavy lines through the stiff color with a pointed match, a piece of cardboard with a comb-like edge, or anything that suggests itself. Or take another color and, using the point of the brush, drag it over the paper with an up-and-down motion.

If the cardboard comb is drawn across the paper with a wavy motion diagonally, using two colors, the effect is often striking, as one color will merge into the other. Drawing a feather over the surface will produce designs somewhat resembling marble.—E. B.

Emergency Fuse Plug

MY HOUSE lights went out because of an overloaded circuit one night and there were no spare fuse plugs on hand. I took off the plug of an electric iron and inserted in the slots a single strand of fine wire from a waste piece of lampcord, as shown. This served until the next day.—O. A.



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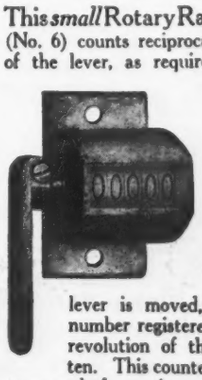
The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.

Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-back *Revolution* Counter of similar model, $10.00 (*list*).

This *small* Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



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"SEE that coupon? Remember the day you urged me to send it to Scranton? It was the best thing I ever did.

"Mr. Carter called me in to-day. Said he'd been watching my work for some time—ever since he learned I was studying with the International Correspondence Schools.

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You, too, can have the position you want in the work you like best. Yes, you can.

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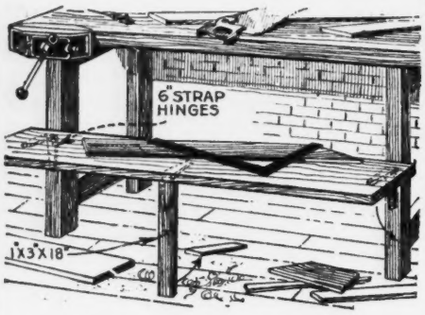
Handy Support for Sawing Is Hinged to Bench Legs

TO SAW off or rip a board is difficult unless it is properly supported, as on carpenter's saw horses. In my own home workshop, however, I have found that the saw bench illustrated serves the purpose very well and does not take up extra room.



When not in use, the sawing support drops down out of the way

A 12-in.-wide board, as long as the distance between the front legs of the bench, is needed. Fasten it with two 6-in. strap hinges to the legs, and provide one or two short front legs for the board, about 1 by 3 by 18 in. When not in use, the board hangs down out of the way.—ROBERT L. WHITMAN, Miami, Fla.

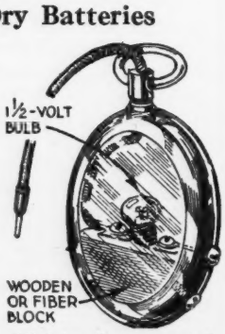
Concrete Flower Pots

Stove-pipe set in concrete wall

WHEN making concrete sides for a small porch and steps, I buried several stove-pipes vertically in the cement. These saved cement and provided openings that were used as flower pots.—O. M. A.

Testing Dry Batteries

FOR testing dry cells, a 1½-volt miniature electric lamp is a fairly reliable guide. If it lights brilliantly, you may be sure you have a pretty good cell, while if it glows faintly, the cell is played out.



Miniature lamp mounted in an old watch-case

A neat way of mounting the bulb is illustrated. The case of a discarded dollar watch is used. Fasten a piece of hard fiber or wood with two or three small screws in the end opposite the stem.

On this block mount the essential parts of the miniature socket. Connect one terminal with the metal case and the other with a short piece of flexible cord brought out through the hollow stem.—JAMES P. LEWIS, Golden, Colo.

Take This Loop on Trial

Ten days to test out this remarkable loop right in your own home. The only loop aerial of its kind. Flat as an atlas, extremely compact and all enclosed in polished Bakelite, with binding posts for various wave meter lengths.

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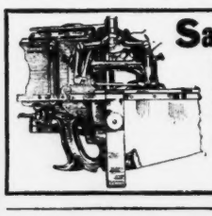

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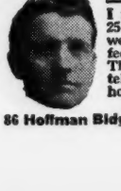


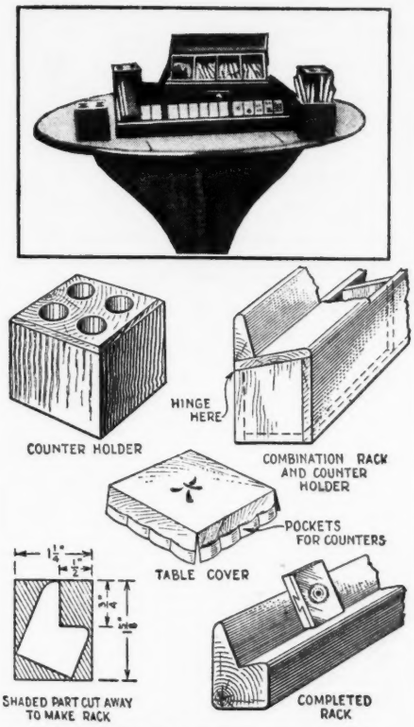
—Every Deaf Person Knows That. I make myself hear after being deaf for 25 years with my Artificial Ear Drums. I wear them day and night. They are perfectly comfortable. No one sees them. They stop head noises. Write me and I will tell you a true story, how I became deaf and how I make you hear. Address. **Geo. P. Way**

Artificial Ear Drum Co., Inc.
86 Hoffman Bldg., 2539 Woodward Ave Detroit Mich.

Simply Made Chinese Game Racks and Counter Holders

CHINESE game racks and counter holders are easily made. The racks may be shaped in various ways, but one of the most convenient is to cut them from pieces of wood 1¼ by 1⅝ by 16 in. Cut out the rabbet for the tiles with a ½-in. plow or rabbet plane ¾ in. deep. The rest of the wood then may be planed to shape with an ordinary plane. If you have a combination plane that will allow you to cut at an angle, you can save work and use smaller stock.

The counter holders are 2⅞-in. square blocks with four 1-in. holes bored in the top to a depth of 1¼ in. Use the end grain for the top and dress it smooth



Finished racks and counter holders, details of construction, and sketch of table cover

before boring the holes. Chamfer or round the upper edges.

Four racks and 4 holders comprise a set. As the amount of wood used is insignificant, it is well to use a cabinet wood such as mahogany, although there are many excellent stains on the market, so that a pleasing set may be made from more common wood.

Take extreme pains in finishing your work, so that it will be in keeping with the workmanship of the tiles and the game cabinet. The method of French polishing described in the article, "Waxing and French Polishing Old Furniture," on page 113 of the November, 1923, POPULAR SCIENCE MONTHLY, is good. If preferred, three of the racks may be lacquered black, and the fourth a Chinese red.

The combination rack and holder illustrated is a long box made of strips 3/16 or ¼ in. wide, except for the tile rest, which is planed from a piece ½ in. thick. The inside dimensions should be about 1¼ in. square and 16 in. long. Place 3 partitions in the box to divide it into 4 parts for counters.—S. W. B.

"Some pippin!"

"There's the panel I told you about, Dad. Just the size I need, too."

"MAC got one of those panels last week. He says you can drill the cleanest holes in it you ever saw. His set looks like a million dollars."

Hundreds of radio fans are giving their home-built sets the same snappy, professional appearance by mounting their instruments on Celoron Radio Panels. Some like the glossy black Celoron panels. Others get the mahogany or oak finish. They all find they can drill clean holes anywhere in Celoron panels without chipping the smooth, hard surface.

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Good looks aren't all a Celoron panel gives your set. This panel's high dielectric strength increases the volume of your set and helps you get results from your instruments that you wouldn't get with a cheap panel.

Celoron, a bakelite product, is one of the best insulating materials known. It is approved by the U. S. Navy and U. S. Signal Corps. Leading radio manufacturers mount their parts on Celoron bases.

Celoron Radio Panels come cut in the following standard sizes:

1—6 x 7 x ⅛	5— 7 x 18 x 3–16
2—7 x 9 x ⅛	6— 7 x 21 x 3–16
3—7 x 12 x ⅛	7— 7 x 24 x 3–16
4—7 x 14 x 3–16	8—12 x 18 x 3–16
9—7 x 26 x 3–16	

Special sizes can be cut to order from sheet stock. See your dealer.

Ask your dealer for a Celoron panel. You can identify it by the Celoron label that is on every panel. These panels come already cut in nine standard sizes ready for working. A dust-proof glassine wrapper protects each panel surface. Full instructions for working are on every envelope.

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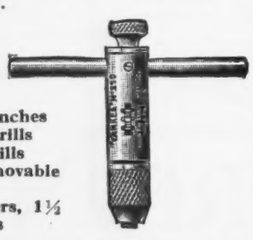
No. 1251 Same as No. 251 except 13 inches in length for work requiring long reach.

Some Other "YANKEE" Tools



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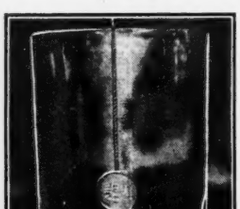
"YANKEE" TOOLS
Make Better Mechanics

How to Construct Apparatus for Magic Pendulum Trick

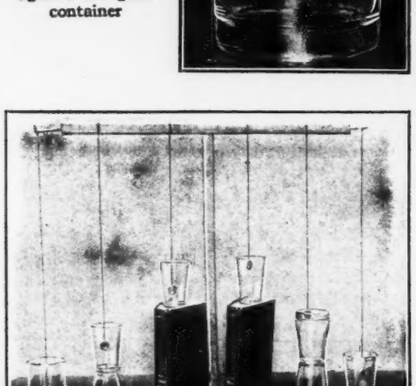
By Kenneth B. Murray

THE magic pendulum trick is a mystifying and entertaining stunt performed with apparatus any amateur mechanic can construct easily and cheaply.

On an ordinary table are placed a number of glass receptacles. In the center of the table is a wooden tee, from which are suspended coins or pendulums, one hanging inside each of the glasses. Sitting away from the table, the performer concentrates his gaze upon any pendulum selected by the spectators and causes it to quiver slowly, to gain momentum, and finally to swing back and forth and hit the sides of the glass. The other pendulums are slightly agitated, but they do not swing. At any time the spectators are allowed to examine the apparatus.



One of the pendulums is shown at the right and the entire visible apparatus, below. The performer makes any given pendulum swing against its glass container



The cross is made of two 20-in. lengths of ½-in. square wood and is set in a wooden block. The coins, preferably pennies, are glued to the cords, and the latter can be tied to the cross arm in view of the audience. This completes the visible apparatus, aside from the glass receptacles used.

The part not seen by the spectators is a length of rubber tubing and a bulb, such as is used with the shutter release of some cameras. The tubing should be more than 6 ft. long. To the end opposite the bulb is cemented a small, heavy rubber balloon. This outfit is placed under the rug or carpet, with the bulb by the operator's chair and the balloon under one leg of the table, which should be of light construction. Under the table leg next to this one should be placed a common button to help balance the table more easily. The operator has then merely to press on the rubber bulb with his foot to obtain an imperceptible movement of the table, which will start

(*Continued on page 117*)

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Write for literature including station calls, hints on battery upkeep and wiring diagrams for basement installation of batteries. We'll furnish you name of dealer who will supply you the genuine FF charger.

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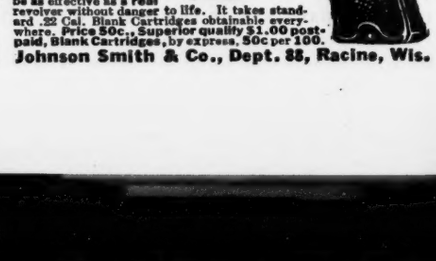

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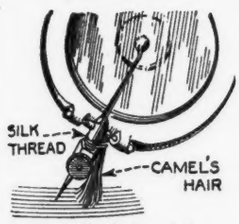
Johnson Smith & Co., Dept. 88, Racine, Wis.

Brush on Needle Holder Dusts Phonograph Record

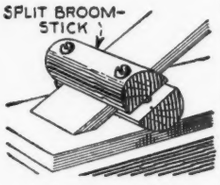
BRUSHING off a phonograph record before each playing gets to be a nuisance and one is apt to let the job slide. It can be done away with entirely by cutting the bristles off a camel's-hair brush of fairly good quality and binding them to the needle holder so they will brush the record just ahead of the needle. A flick of the finger takes off the accumulated dust.—W. J. L.



Camel's hairs tied to needle holder

Simple Guide for Sharpening Chisels and Plane Irons

FEW amateur craftsmen have not suffered a severe blow to their pride at the first effort in sharpening a chisel or plane bit on an oilstone. The original bevel of the tool is without doubt the best all-purpose cutting edge obtainable, but to maintain it through frequent sharpenings is a problem. It can be accomplished by making a broomstick guide, as illustrated.



The broomstick guide in use

For a 1-in. chisel, cut a round section of broom handle 2 in. long; rip it down the center and attach it with screws to the blade at the desired point to give the proper bevel. To change to any other bevel, simply tap the block up or down the blade.—WILLIAM EVERT SMITH, M.D., San Francisco, Calif.

Apparatus for Pendulum Trick

(*Continued from page 116*)

all the pendulums swinging very slightly.

The problem is now to cause only the coin selected by the spectators to swing. You will notice that there is at least 1 in. difference in the length of each cord. Upon this fact hinges the trick. It takes a long pendulum longer to swing from side to side than a short one.

The operator directs his attention on the pendulum selected by the spectators. When it is about to start on a swing, he releases the pressure on the bulb, and the swinging of this particular pendulum is again intensified. Although the desired pendulum will swing easily and freely, you will find that the others will remain nearly stationary.

Should the spectators ask that a different table be used, the operator can transfer the apparatus to the selected table, and, after explaining that the first table had become highly "magnetized" from use and that the new table is lacking in magnetism, he can "make connections" by sitting with his hands on the table, all the while moving it very slightly so that the pendulum selected will swing.

Stamping the retail price at the factory

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$7.00 and $8.00 SHOES
Many at $5 & $6 ~ Boys' at $4.50 & $5

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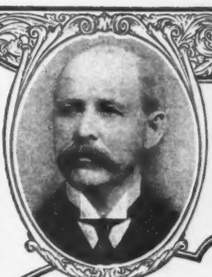

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A bright tan Russia Calf Oxford for Men on a wide brogue last. New, attractive pattern with black stitching and eyelets. Patent Leather Cork Welt and trimming around top; rolled heel. A smart, up-to-the-minute style for Spring and a wonderful value, $8.00.

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W. L. DOUGLAS shoes are demanded by more people than any other shoes in this country. They are put into all of our 116 stores at factory cost. We do not make one cent of profit until the shoes are sold to you. It is worth dollars for you to know that when you buy shoes at our stores ***You Pay Only One Profit.***

NEVER have you had the opportunity to buy such wonderful shoe values as you will find in W. L. Douglas shoes in our retail stores in the principal cities and in good shoe stores everywhere. If you do not live near one of our stores, ask your shoe dealer for W. L. Douglas shoes. If he cannot supply you, write for catalog showing how to order shoes by mail, postage free.

W. L. DOUGLAS SHOE COMPANY
124 Spark Street, Brockton, Mass.

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CENTRAL AUTO SUPPLY CO. Dept. 122, LOUISVILLE, KY.

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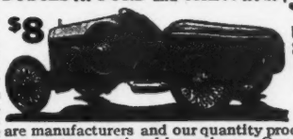

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"I have been watching submarines 8 miles off the coast."—P. Grush. "Can see children playing in school yard 6 miles away."—P. H. Henningston. "Read the numbers on freight cars mile away. See mountains on moon."—A. O. Palmer.

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Because of a fortunate purchase from a large European manufacturer we can give you a big bargain. Be first in your neighborhood; entertain your friends. **Send no money;** send only name and address for telescope complete by parcel post. On arrival deposit with Postman only $1.85 plus a few pennies postage. **Satisfaction guaranteed** or money refunded. Order **today** while the supply lasts.

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Improved
Millers Falls Ratchet Brace No. 772

The old quality —new capacity

WE'VE made this fine brace for years. It's been hard to improve but we've done it — with an improved chuck with square opening in the hood. It now holds larger bit shanks — everything you would care to use in a brace. One of the strongest and sturdiest of twenty styles of braces manufactured by Millers Falls Company for 50 years. You can't ask for more in a ratchet brace than No. 772 offers. You owe it to yourself to have one.

MILLERS FALLS COMPANY
Millers Falls, Mass.
28 Warren St. New York — 9 South Clinton St. Chicago

Read the Specifications

Cocobolo head and handle.

Chuck — Lion ball bearing, with improved master alligator jaws. Holds auger bits to size 32/16, round shanks from ⅛ to ½ inch, No. 1 Morse taper shanks, and No. 2 Expansive Bits.

Ratchet — boxed. Head — ball bearing. Square opening in hood. **Handle** — inserted metal rings. **Sweep** — 10 in. Made in four other sizes, with sweeps from 8 to 16 in.

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SINCE 1868

Manufacturers of Mechanics' Tools, Hack Saws and Automobile Tools

"WONDER" COLD PIPE, TUBING & BAR BENDERS
Standard of the World.
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe $1.00
Send for Catalogue.
AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. *One Year to Pay.* Boston, Mass.

SUPER HETERODYNE TRANSFORMERS
of Standard Branston Quality
ARE NOW READY FOR DELIVERY

Ask your dealer or write for complete information.

The Super Heterodyne circuit, as now perfected, is simple to hook up and easy to operate. You can log all stations accurately and select any one at will. Results are greatly superior to any other form of reception. The last obstacle to your building one of these remarkable sets (the scarcity of suitable transformers) has now been removed.

We furnish complete circuit diagrams, blue prints of panel layouts, apparatus placement, and a manual that makes it easy to build and operate a Super Heterodyne Receiver.

Our R-91 Intermediate Radio Frequency Transformer works on a high wave length, where there is no code interference. It is sharply tuned and completely shielded. R-92, Special Transformer Coupler, is arranged for the last stage of Intermediate Frequency. R-90, Oscillator Coupler, is correctly designed for its work. It covers a band of wave lengths from 150 to 800 meters, and generates the maximum amount of current. R-93, Antenna Coupler, is specially designed for using antenna, if desired, instead of a loop.

Rigorous tests have proved this apparatus far superior to anything that has heretofore been available for this work.

See your dealer at once, or write us today for all information.

CHAS. A. BRANSTON, INC.
809 Main St., Buffalo, N. Y.
Manufacturers of the famous Branston Violet Ray High Frequency Generators

Add miles and smiles with Branston Radio Parts. In Canada, Chas. A. Branston, Ltd., Toronto, Ont.

$25.00 in Prizes
See top of page 8 in front of book for full details

$2.50 Down — Then Small, Easy Monthly Payments for the "Bicycle Supreme"

BABSON
Motorbike Model

Yes! Only $2.50 Down and small easy monthly payments for this king of bicycles —the last word in strength, durability, comfort, easy running and convenience!

30 Days FREE Trial

To prove to you that the wonderful Babson Motorbike is everything we claim, you may ride it for 30 days without the slightest obligation to buy, unless absolutely satisfied.

Write Today! Get our wonderful offer before it is too late Learn all about our other models for men, women, boys and girls. Learn how you can make a lot of money as a rider agent. Don't miss this chance! Write TODAY.

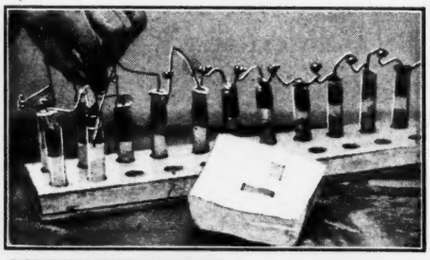
Babson Bros. Dept. 13-64 19th Street and California Ave., Chicago, Ill.

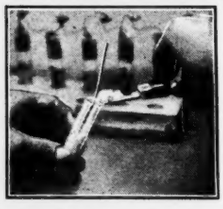
Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THE radio fan who takes pride in constructing as much of his apparatus as he can, will find it not at all difficult to make very efficient B batteries that not only have a long life, but also can be renewed again and again for a few cents when they run down. Each cell of the battery is a modified Daniell cell and gives approximately 1 volt. To give from 20 to 23 volts, 22 of the cells are used, the voltage depending upon the care taken in making each cell.

The containers are small glass tubes, in which photo developer had been contained. Almost every amateur photographer accumulates many of these. Those who do not do their own developing can





Inserting a zinc electrode in one cell of a partly finished battery (above) and adding plaster of Paris to a cell (at left)

obtain the tubes for the asking from friends who do photographic work. Two rows of holes, 11 holes to the row, are bored in a 1-in. thick board to take the tubes. Under this board another thin board is nailed.

The other materials necessary for the battery are copper sulphate, plaster of Paris, zinc, zinc sulphate, rubber insulated wire, and a little oil. A blowtorch or Bunsen burner for melting the zinc should be at hand, as well as a dry clay or sand mold for forming the zinc electrodes.

Take the rubber insulated wire, after removing any cotton or silk outer wrapper, and expose about 1 in. Bend this end into a circle to fit the bottom of the tube, and cut the wire off about 2 in. longer than the tube. Then bare 1 in. of the outside end. This is the positive pole of the cell.

Crush some copper sulphate and fill the tube one third full with it; then add a concentrated solution of copper sulphate until it is level with the crystals. A concentrated solution is made by dissolving as much of the chemical as possible in water.

Place some powdered plaster of Paris on top of the crystals, add a little water,

(*Continued on page 119*)

Home Workshop Chemistry

(*Continued from page 118*)

and then add a little more plaster and water until a membrane about ½ in. thick is formed. Let this stand until the plaster has set.

Meanwhile, melt some zinc and pour the molten mass into a mold. The shape of the mold is such that the casting will fill the tube for half its diameter and about a third its length. Just before pouring the molten zinc, a copper wire about 3 in. long and bare throughout its entire length, is placed near the top of the mold. The wire should be slightly hooked so that the molten zinc will grip it tightly and make an excellent electrical connection with it.

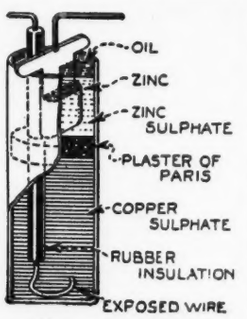


Diagram of one cell

When the zinc electrode is cold, place it in the tube, the upper part of the tube having meanwhile been partly filled with a very dilute solution of zinc sulphate in water. One ounce of the salt is more than sufficient for 100 cells of this type.

When all the cells of the battery have been made in this manner, they are hooked up. This is accomplished by uniting the negative zinc pole of one cell to the positive copper pole of the other, and by connecting the negative of this one to the positive of the third cell, and so on. The connection may be made simply by connecting the wires together with brass nuts and bolts. Finally, one negative and one positive pole remain free. These are connected with the receiving set or with other 22-cell batteries of the same type.

The battery will give constant voltage until it is dead, and it is dead only after all the copper sulphate has been dissolved and plated or deposited on the positive wire electrode. It is well to cover the cells with a layer of oil to prevent evaporation. Then, too, it is advisable to renew the water, or solution of zinc sulphate when crystals make their appearance.

All that is necessary is to take a pipette or small glass tube and remove the liquid, or as much as possible, and add fresh water. Do not dissolve any zinc sulphate into the renewed water, as a sufficient quantity of this chemical will still be present in the cell to promote action and generate electricity.

The action that takes place is as follows: The copper sulphate plates out on the copper electrode; sulphuric acid becoming free, attacks the zinc; ions are set free and the zinc dissolves. This action takes place only when the battery is being used.

VARNISH that peeled has spoiled many a job. Test yours before using it by applying some to a thin sheet of metal and bending the metal. Good varnish will stand the strain.

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INTERCHANGEABLE
Socket Wrenches

Buick Kit - $8.10

Makes 60 Combinations.

Other Kits for all cars priced in proportion.

DEALERS: Write for agency details. Sales are easy under our unique plan.

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A seedy looking top spoils its appearance. Get a Liberty Custom Made Top. It's fun putting it on, simple directions furnished. Save a big labor bill. We are manufacturers of tops, side curtains and seat covers, for any make or model car. Amazing values. Special proposition for Fords, Chevrolets, Dodges and Maxwells. Write today for big money saving catalog.

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Superior Automobile Trouble Light

Only $1.00 postpaid or C. O. D. if you wish.

Made of the highest grade materials, furnished in either single or double contact, complete with 10 ft. cord, 2 c.p. bulb, guard and socket. Order yours today.

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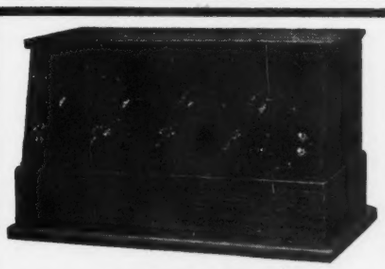

MAKE MONEY-SELL RADIO!

Radio offers the biggest money-making opportunity on earth today. And the *Ozarka Plan* opens the door to this big opportunity. Look at the picture of this beautiful Radio Receiver. This picture was made from an actual photograph. By the Ozarka Plan that Radio Instrument can be the product of your own making—easily, simply and surely. It will be *yours to make, to sell* and *to reap a* rich reward in cash profits.

No experience necessary. You need not have much cash. All you need is spare time, determination and action. If you're that kind of a chap, the Ozarka Plan will start you on a straight line toward a real money-making business of your own. It can be as big and as profitable as you are ambitious to make it. We want good men in every county. Exclusive territory is going fast. Be sure and give us the name of your county. Write today for the Ozarka Plan. A wonderfully interesting book, of facts, particulars and proofs. It is FREE. Act now.

OZARKA, INC.
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DO YOU LIKE TO DRAW?

CARTOONISTS TRAINED BY W. L. EVANS

MAKE MONEY

Some of the **cleverest cartoonists** are **former students.** They had **no experience** before enrolling, but worked at the lessons **during their spare** time and found CARTOONIST EVANS' METHOD **"easy to learn"** and are now **making good money.** It is not hard to learn to draw **originals** when shown in a **practical way.**

The School is recommended by well known cartoonists because they know the students are **handled right.**

If you like to draw and want to be able to sell your drawings, send a sample of your work (either a copy or an original) and let us see what you can do. We will send you the **portfolio of cartoons** and **full details** about the school.

The Course is NOT EXPENSIVE

THE W. L. EVANS SCHOOL OF CARTOONING
825 Leader Bldg., CLEVELAND, OHIO

This Man Wouldn't Stay Down

HE was putting in long hours at unskilled work. His small pay scarcely lasted from week to week.

He saw other men promoted. Then he learned the *reason*. They had special training. He made up his mind to get that kind of training.

He sent to Scranton a coupon like the one below. That was his first step upward.

The reward was not long coming—an increase in salary. Then he was made Foreman. Now he is Superintendent.

It just shows what a man with ambition can do!

What about you? You don't *have* to stay down. You *can* climb to the position you want in the work you like best.

The way to do it is easy—without obligating yourself in any way, mark and mail this coupon.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7685-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING COURSES

☐ Business Management	☐ Salesmanship
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☐ Traffic Management	☐ Show Card Lettering
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☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
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☐ Electric Lighting	☐ Blue Print Reading
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☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
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Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

DIAMONDS

Here at 60% of Market Price

This snappy perfectly cut diamond 7-8—3-32 ct. at $52.50 among bargains we list. Many other big values in our lists. Buy *HERE*. Loan values the price basis, not market values. This 75 year old *diamond banking firm* has thousands unpaid loans and other bargains must sell NOW.

Why Pay Full Prices

Any diamond sent for absolutely free examination at our risk. No obligation. No cost to you.

Send for Latest List

Diamond Bargains described in detail. *Tells of guaranteed loan values*, unlimited exchange privilege, details of free examination. *Send now.*

JOS. DeROY & SONS 4710 DeRoy Bldg. Only Opposite Post Office, Pittsburgh, Pa.

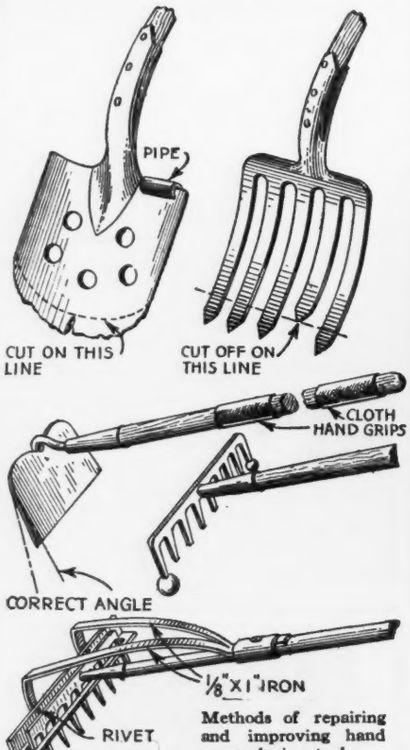
How to Get Your Gardening Tools Ready for Spring

By Joe V. Romig

NOW is the time to get your gardening tools in shape for spring and summer.

Take your shovel, for instance. Is its edge badly bent and ragged, perhaps from trying to chop away ice from frozen sidewalks? Trim the edge well back of all cracks by cutting it away with a hammer and cold chisel, resting the shovel on a flat piece of iron or steel. Then dress it up with a file, and your shovel is almost as good as new.

Amateur gardeners who do not wear heavy shoes are handicapped in spading by the sharpness of the upper edge of the shovel blade. To overcome this, a section of hose or gas-pipe is slit with a hacksaw and slipped over the edge, as shown. To prevent earth from sticking to the face of



Methods of repairing and improving hand gardening tools

the shovel, try drilling a few holes through it; this usually will cure the trouble. When the cross handgrip of a spade splits, bind it with tire tape.

If a tooth of a garden spading fork breaks off, do not attempt to use it until you have sharpened it or have the remaining long teeth cut down to the length of the broken one.

The hoe is a much neglected and badly used tool. To make one cut the weeds readily, sharpen the bottom of the blade. Drilling a few holes will prevent the soft ground from caking on the face of the blade, but they must be spaced so as not to rob the blade of its strength.

The angle of the blade to the handle should be a little out of square, toeing in toward the under side. If your hoe works awkwardly, try bending it as indicated.

The rake is another tool put to many uses by the householder. He uses it for raking his garden, lawn and back yard,

(*Continued on page 121*)

"Old Town Canoes"

Push across to the bathing beach

DOWN by the wooded bank, a stone's throw from the cabin, an "Old Town Canoe" is moored. What a trim, graceful craft it is.

Each "Old Town" model is patterned after a real Indian canoe. "Old Towns" are light and steady. They are low in price too. $64 up. From dealer or factory.

The new 1924 catalog is beautifully illustrated. It shows all models in full colors. Write for your free copy to-day.

OLD TOWN CANOE CO.
1494 Main St., Old Town, Maine, U. S. A.

SAVES YOU 50%

Genuine AHLBELL NEVERLEAK Solid Rubber Case

2-Year Unconditional Guarantee!

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For AUTO and RADIO

Tremendous saving for you on this non-leakable, Guaranteed Superior Quality Storage Battery. One-piece indestructible case, can't leak, spill, or injure rugs or clothing. No more breakage of jars or acid eaten boxes. **2-year written unconditional guarantee** covers leakage as well as performance and fully protects you. Silver-S quantity production and **Big Buying Power** makes possible this unheard-of-value.

50%—SEE WHAT YOU SAVE—50%
5 per cent Discount for cash in full with order.

AUTO PRICES		RADIO PRICES	
6-V, 11 Plate -	$13.00	6-V, 100 Amps.	$13.50
6-V, 13 Plate -	15.00	6-V, 120 Amps.	15.50
12-V. 7 Plate -	16.00	6-V. 140 Amps.	17.00

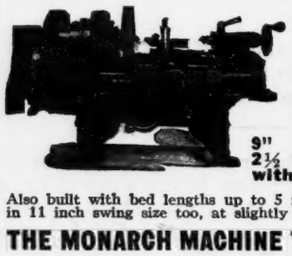
Inspect this Wonder Battery. Read our 2-year Guarantee before you pay one cent. Satisfy yourself you are getting the best battery made—at 50 per cent saving. Shipment made by Express C. O. D. subject to examination. No delay. Send name and address and style wanted TODAY.

SILVER-S BATTERY COMPANY
201 E. Ontario St., Dept. 52, Chicago, Ill.

SEND NO MONEY

Catalog FREE!

Send for the MONARCH Lathe Catalog—fully illustrated—every type Engine Lathe up to 30 inches swing. Illustrated here is the *MONARCH Jr. Lathe*—an accurate, compact, trouble proof Lathe for Inventors, Experimenters, Mechanics and Auto Repairmen. Fully equipped—semi-quick change gear—auto. safety devices.



$270

9" lathe—2½ ft. bed—with bench legs

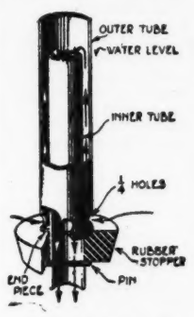
Also built with bed lengths up to 5 feet. Made in 11 inch swing size too, at slightly higher price.

THE MONARCH MACHINE TOOL CO.
401 Oak Street SIDNEY, Ohio

Washing Photographic Prints

ANOTHER accessory for washing photographic prints along somewhat similar lines to that described by Mr. Schalek in the September, 1923, POPULAR SCIENCE MONTHLY is a drain plug, as shown below.

A short length of ¾-in. brass tubing, with several ¼-in. holes drilled near the lower end, is closed at the lower end with a piece of thin brass plate, through which a ½-in. hole has been drilled. A length of ½-in. tubing is slipped through this hole and soldered.



Drain plug for the photographer's sink

Obtain an ordinary rubber drain plug of a size to fit the sink drain, cut a hole in it, and push the end of the smaller tube through. A brass pin holds the tube in place. The heavier hypo solution is then always drawn off first.—F. M. W., Jr.

Your Gardening Tools

(*Continued from page 120*)

and it has to handle earth, straw, and litter of all kinds. Sometimes it serves as a snow-scraper in the winter after a piece of thin galvanized iron has been fastened to the teeth. The landscape gardener wires a piece of wood to the teeth to make a leveling scraper.

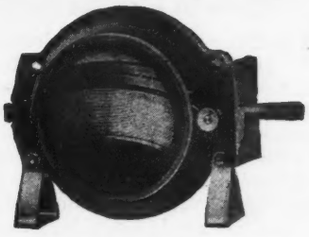
Like all other tools, the rake is apt to give trouble some time or other, usually when one attempts to rake up grass and leaves, which clog up the teeth. To facilitate their removal without stooping or using the hands, the rake should be fitted with a leaf remover made as illustrated.

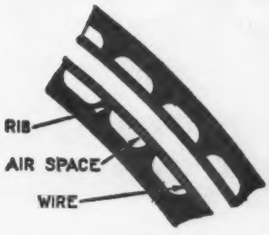
A small piece of angle iron is drilled with holes spaced so as to slip loosely over the teeth. Attached to the upright leg of the angle is a holder made from ⅛ by 1 in. steel stock, bent, riveted, and screwed to the rake handle as shown. This holds the angle iron up against the top rail of the rake. To remove leaves and grass, the rake is turned over and hit on the ground, thus pushing the angle downward and clearing the teeth.

Wooden balls about 2 in. in diameter, when placed on each end tooth of a rake, act as runners and prevent the teeth from pulling out the grass. The balls are bored or drilled and pressed on the teeth to give the desired clearance. The taper of the teeth holds them in place.

Garden tools mainly have wooden handles and these become rough and weather checked. Old handles should be sandpapered and given a coat of good spar varnish. If treated the same way, new handles will wear twice as long and will not check at all.

Some of those who work in the garden only in the evening and after work, do not like the feel of bare wooden handles, yet do not like to wear working gloves. Canvas may be glued on the handle of any garden tool to afford a warm, comfortable, and firm grip.





The Paragon Variometer No. 60

reduces dielectric losses to the minimum. It is the first variometer to combine coils surrounded by air with the mechanical strength necessary in such an instrument. It has no equal in the radio field.

Both stator and rotor forms are of polished black, moulded Condensite, each having 24 narrow raised ribs upon which windings are supported, thus practically surrounding them with air. This design, the result of eight years' experience, meets the rigid electrical requirements of PARAGON Receivers and fulfills the high mechanical standards of PARAGON parts. Price $5.00.

Write for illustrated catalog of Paragon Radio Parts

ADAMS-MORGAN CO., 18 Alvin Avenue, Upper Montclair, N.J.

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RADIO PRODUCTS

For your home shop!

PARKS
Cabinet Shop Special
$225
with all attachments and motor

HERE'S an all-round woodworker for the small shop. Sturdy, fast and true. The biggest little woodworker ever built. Saw table has 8-in. rip and cross-cut saw, and 4-in. jointer and borer. You can choose from these extra attachments: band saw; shaper; sander; lathe; and motor. Send for Bulletin C-S and complete Parks catalog.

The Parks Ball Bearing Machine Company
1547 Knowlton St., Cincinnati, O.
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PARKS
WOODWORKING MACHINES

Time to Overhaul The Old Bike

The first warm days will be here before you know it. Better look the old bike over now, so you will have it ready when the gang says "let's go."

Will you be out with the rest of them, or will a flat tire keep you home?

Get some Neverleak today, inject it in your tires and you won't have to worry about punctures all summer.

Neverleak comes in the yellow, green and white tube. Be sure you get the original. Price 25c at all bicycle and repair shops.

Buffalo Specialty Co., Buffalo, N. Y.

NEVERLEAK
TIRE FLUID
"HEALS PUNCTURES ON THE RUN."

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

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USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

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.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Fire Insurance Expert
.....Vocational Guidance	.....Wireless Radio
....Business Law	.....Undecided

Name .....

Address .....

A Toy Electric Railway Track Made in Flexible Sections

THE tracks for this toy electric railway are ribbon brass ¾ in. wide and 1/32 in. thick cut into equal lengths of about 2 ft. each. Near the bottom of one end of each length a small brass tube is soldered. At the other end and at the same side is soldered a brass wire that will fit snugly into the tube of an adjoining strip (Fig. 1).

The ties are ½ by ¾ in. strips of wood and are a little longer than the distance between the outside tracks. One narrow side of each tie receives three saw cuts

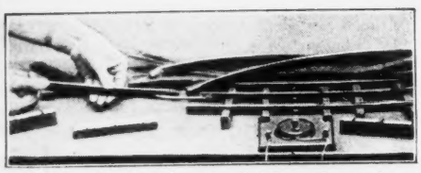


Fig. 1. Details of the track joints, ties, and method of making electrical connections

one third of the way through. The two outer cuts are for the tracks, while the center is for the third rail. Five to six of these wooden ties are used for each 2-ft. length of track.

The brass is bent easily, and the wooden ties hold the curve in place. In this way a curve can be made at any point in the line.

The motive power is provided by any electrical toy motor with four flanged wheels added at the base. The drive is connected with these wheels either directly through toy gears or through a chain and sprocket. Over the motor a housing is placed. This can be of any design, such as a trolley (Fig. 2), passenger or freight car or a steam or electric engine.

At the point where the electrical connections are to be made to the rails, a thin board is placed under the track. To this board are screwed three small clips made of the brass ribbon, each of which grips one of the tracks. On the same board is mounted a switch (Figs. 1 and 2).

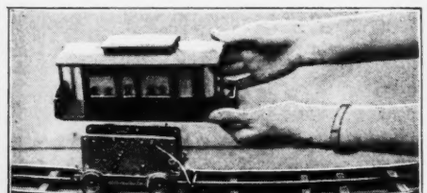


Fig. 2. The motor mounted on wheels ready for the car body, and the control switch

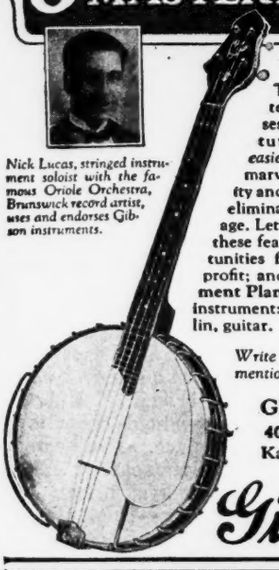
An insulated wire runs from one binding-post of the battery or transformer to both of the clips attached to the outside tracks. The wire from the other binding-post goes to the switch and from the switch an insulated wire runs to the clip connecting with the middle rail.—E. B.

Toy Motor-Boat Made Cheaply

TOY-MAKERS, whether young or old, will be interested in an article scheduled for early publication, "Egg Crate and Old Toy Motor Make Model Boat." This will tell how to build cheaply a good-sized toy motor-boat.

Get these Facts about the New MASTERTONE

Nick Lucas, stringed instrument soloist with the famous Oriole Orchestra, Brunswick record artist, uses and endorses Gibson instruments.



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Medical authorities agree that 65% of all men past middle age (many much younger) are afflicted with a disorder of the prostate gland. Aches in feet, legs and back, frequent nightly risings, sciatic pains, are some of the signs—and now, a member of the American Association for the Advancement of Science has written a remarkably interesting Free Book that tells of other symptoms and just what they mean. No longer should a man approaching or past the prime of life be content to regard these pains and conditions as inevitable signs of approaching age. Already more than 10,000 men have used the amazing method described in this book to restore their youthful health and vigor—and to restore the prostate gland to its proper functioning. Send immediately for this book. If you will mail your request to the Electro Thermal Company, 4032 Main Street, Steubenville, Ohio—the concern that is distributing this book for the author—it will be sent to you absolutely free, without obligation. Simply send name and address. But don't delay for the edition of this book is limited.

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WE FURNISH EQUIPMENT TO START

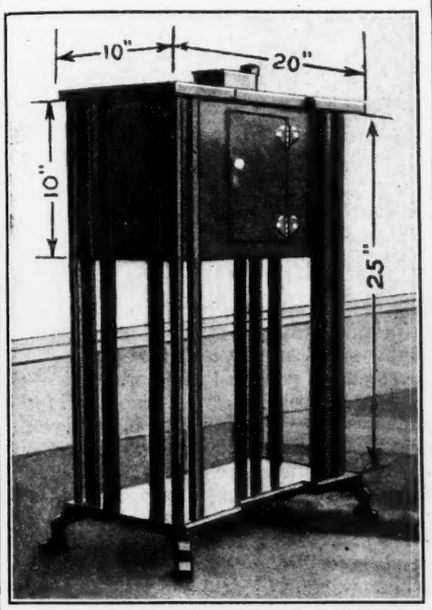
Earns $90 Building Four Simple Smoking Cabinets

ALTHOUGH not hard to make, the tobacco cabinet or humidor illustrated will grace any smoker's den or living-room. I have made three of these of quartered oak, for which I received $20 each, and one of walnut, which brought $30.

The stock required is:

2 pieces, 1 by 10 by 20 in., for top and bottom
12 pieces, ¾ by ¾ in. by 2 ft. 2 in., for legs
2 pieces, ½ by 6½ by 10½ in., for box ends
2 pieces, ½ by 10½ by 15½ in., for box sides
1 piece, ½ by 8 by 6½ in., for door
1 piece, ½ by 6½ by 15½ in., for box bottom

First lay out and cut the top and bottom alike, as indicated. Make the box



One of the finished humidors, showing dimensions that have proved satisfactory

6½ by 10½ by 16½ in. over all, either with mitered corners or ordinary butt joints. Leave the top open and make the bottom of any material at hand. Cut the opening for the door and fit the door.

Next, cut mortises in the top and bottom boards ¾ by ¾ in. and ½ in. deep to take the legs, and also cut a groove or dado in the top board to take the upper edges of the box. Glue the box in first and then the legs.

Sandpaper the smoking cabinet inside and out. Then finish the inside of the box with white enamel and the exterior with stain and varnish to match the color of the other furniture in the room.—H. SCOTT, Sault Sainte Marie, Ont., Canada.

Home Workshop Features

ARTICLES scheduled for early publication include: Novel Trellis Designs for the House and Garden, An Easy Way to Build Garage Doors, New Canvas Canoes from Old, How to Make a Buffet, A Homemade Shaper for the Amateur's Workshop, Building a Toy Motorboat, Attractive and Substantial "Habitant" Rocking Chairs, How to Fix Doors that Bind, A Novelty Trump Indicator, and Making Fire Extinguishers for the Home.

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"They used to avoid me when I asked for a dance. Some said they were tired, others had previous engagements. I didn't 'wake up' until a partner left me standing alone in the middle of the floor.

Posed by Hope Hampton and Arthur Murray

"That night I went home feeling pretty blue. As a social success I was a failure. I wouldn't believe dancing could be taught by mail, but I figured I could risk 25c.—since you guaranteed to teach me.

"Since becoming a good dancer I am invited everywhere. No more dull evenings. My whole life is happier. And I owe it all to Arthur Murray!

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Just send 25c. (stamps or coin) to pay postage, printing, etc., and the lessons will be promptly mailed to you. Don't hesitate. You place yourself under no obligation, write today. Arthur Murray, Studio 136, 801 Madison Ave., New York.

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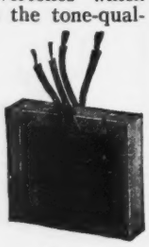
The correct design of the Kellogg transformer is a result of exhaustive study of sound waves and of the audio-frequency currents representing them, and has eliminated to the last degree of distortion of overtones which gives the tone-quality to the wave being amplified. Our 25 years of experience building transformers has developed a one piece silicon steel, laminated core; note the absence of punched holes, which so frequently cause loss of power. Not less carefully made is the brass shield, which makes close mounting possible without interference.



Note also how the ends of the windings are brought out and soldered in plain sight to the terminal posts; there are no concealed soldered joints.

Terminals plainly marked for connecting.

If your dealer or jobber does not handle Kellogg equipment, write us mentioning his name.

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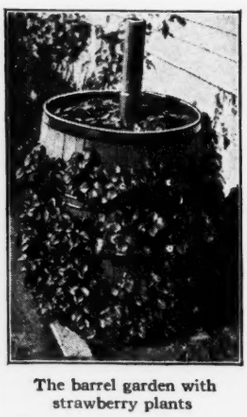
Strawberries and Other Plants Grown in a Barrel

EVEN if you live in a congested city, with little or no gardening space, it is not necessary to forego all the pleasures of gardening. You can resort to barrel gardening, just as an ingenious resident of San Antonio, Texas, has done.

All that is needed is a wooden barrel perforated with holes. Plant in the holes whatever your fancy dictates. In the case of the San Antonian, this happened to be strawberries and quite enough strawberries are grown to satisfy the palates of a small household. With such a forcing barrel, strawberries can be started and grown to maturity much sooner in the spring than they can be in the open garden. After the strawberry crop is over, the plants may be removed and other plants substituted, thus keeping the barrel garden going all summer.



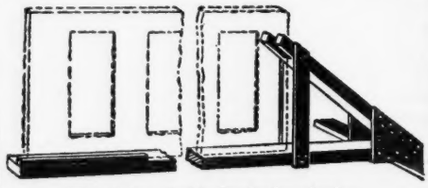
The barrel garden with strawberry plants

Be sure to provide a rich, loamy soil for your barrel, and then see to it that you have an iron pipe running down into the earth. Holes must be drilled in the part of the pipe that is to be buried, so that water poured into it will reach all levels of the soil. Then, if the bottom of the barrel is drilled with small holes, the surplus water will drain out instead of standing and souring the soil.

Quite a variety of small vegetables and flowering plants may be grown in such a barrel, including pansies, petunias, phlox, verbenas, lettuce, onions, and various greens.—A. W. ROE, San Antonio, Tex.

Time-Saving Jack for Doors

FOR holding doors while planing the edges and putting on hinges, the jack illustrated is a time-saver. The base should be long enough to take the highest door to be hung, and the height of the vertical part of the jack must be less than the narrowest door, usually about 2 ft. The end of the door is pushed in the notch of the slanting brace and the lower edge rested against the side strip on the base. The floor supports should be 20 or 24 in. long. The base and slanting brace are 2 by 4 in. pieces; all other material is ⅞-in. stuff.—F. M. ARTHUR, Bethune, S. C.



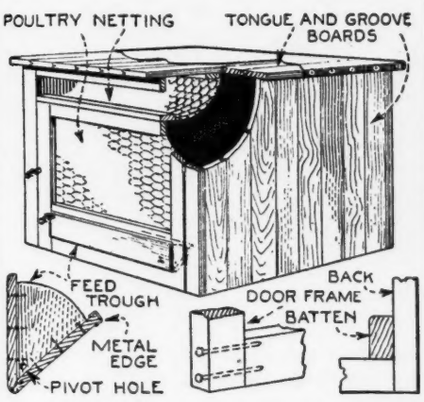
This fixture holds firmly for planing the long edges and fitting the hinges

This Unique Rabbit Hutch Has Hay-Rack and Feed Trough

ALTHOUGH most boys at some time or other keep rabbits, few of them know how to build first-class hutches for their pets. It takes a little longer to build a good hutch like the one illustrated than to use an old box or barrel, but the result is worth while.

The first feature is that all feeding of the rabbits is done quickly without opening the doors, and the second is that the hutches are made on the unit plan, which allows new sections to be added as the stock increases in numbers.

Ordinary 1 by 2 in. roofing laths are used for the front, although any available wood will do. Tongue-and-groove ceiling, ⅛ in. thick, forms the ends and back, and



Food is placed in feed trough or hay-rack without opening the door

common tongue-and-groove roofers serve for the top. A good size for a unit hutch is 2 ft. 2 in. wide, 2 ft. 3 in. high, and 2 ft. 6 in. deep.

Cover the top with duck, preferably 10 oz., painted on both sides, or with prepared roll roofing. The next two units that are added require no top, as they are placed below the first one and merely fastened to prevent slipping.

The feed trough, which is pivoted on the door frame as shown, is tilted forward and filled from the outside with oats or other food. A piece of tin or galvanized iron tacked over the inside edge of the feed-trough prevents the rabbits from gnawing away the wood. The rack above the door is for hay in the winter and grass in the summer. The rabbits pull it through the 1-in. poultry netting, a piece at a time. Since they have to stretch up for it, they obtain much needed exercise, and this keeps them in good condition; it is, indeed, one of the secrets of having large, healthy rabbits.

The wire netting over the door frame is tacked on the inside with small staples. The hay-rack is fastened above the door, and well tacked at the ends.

Rubber-Capped Hammer

IN PLACE of a soft hammer or mallet I keep in my toolkit an ordinary crutch tip of large size. This slips over the head of an ordinary nail hammer I use and converts it into a soft hammer for driving together parts that otherwise might be damaged by hammer marks.—J. M. GRAY, Lansing, Mich.

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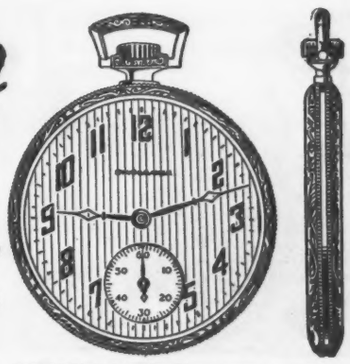

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No difference who you are, where you live or what your age, we will send you the complete "Mandel-ette" outfit absolutely on approval and give you 10 days to test it. If not satisfactory return it. But when you see what elegant pictures it takes—so quick, so easy, with no trouble at all—if you wish to keep it you simply send us 50c per week until our special price of only $10.00 is paid.

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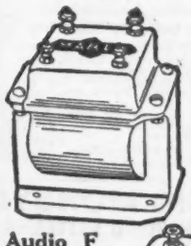

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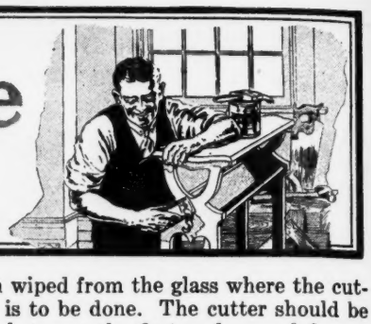
The Shipshape Home



Cutting Glass

IN MAKING repairs about the home it is sometimes necessary to replace a broken pane of glass or do other work that requires the use of glass. The principal difficulty the home worker experiences in such cases is cutting the glass to size.

To do this he must have a glass cutter. Nothing else will take its place; and, since a glass cutter is needed badly when it is needed at all, it is best always to have one in the tool cabinet. There are several kinds on the market, some with a single roll, others with two or more in a sort of turret. I prefer the latter as being more economical if long usage is expected.

The cutter is drawn with firm pressure once along the straight edge

Mark out the size of the glass—and if it is a window pane, do not figure on making it too tight a fit in the glass rabbet—and lay a straight edge along one of the edges you intend to cut. Hold this firmly so that it cannot slip. This is best done by placing the thumb and little finger of the left hand on the glass, and the first, second, and third fingers on the straight edge. Be sure that all grease and dirt have been wiped from the glass where the cutting is to be done. The cutter should be held between the first and second fingers of the right hand, resting well down between the fingers on the knuckles, with the fingers pressing the flattened part of the handle firmly against the thumb.

Use only enough pressure on the cutter to make a clean, even scratch. Don't go over the cut twice, as the fine dust from the glass of the first cut will dull the wheel.

If the cut has been made with even pressure, the border or waste part can be broken off easily with the fingers, starting nearest yourself and working away. If the border is narrow, it should be nipped off by means of the breaker teeth on the cutter.

It goes without saying that the glass being cut must rest on a flat, clean place or the glass will be broken at the very start by the pressure of the cutter. Any one who will practise a short while cutting waste pieces in this way, will find it surprisingly easy.—HENRY S. LARABY, New Haven, Conn.

Mounting an Ironing Board

WHEN there is a chair rail around the kitchen wall, it is comparatively easy to mount an ironing-board so that it will fold up flat against the wall when not in use.

Hinge a leg to the board, as shown, and fasten on the upper side of the leg near the lower end a block shaped as indicated from 1-in. lumber. Its outer edge is covered with a strip of felt, which rests against the plaster wall when the board is raised.

The board itself is hinged to the plate rail and a cleat and stop block are fastened beneath the hinged end, as represented, so that the leg, in the raised position, rests in a sort of cradle or notch. An L-shaped latch of strap iron is pivoted to the cleat, so that it can be turned to hold the leg in place when the board is up, and this automatically prevents the board from falling.

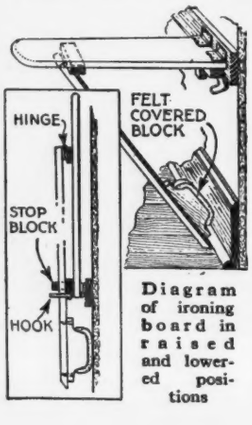
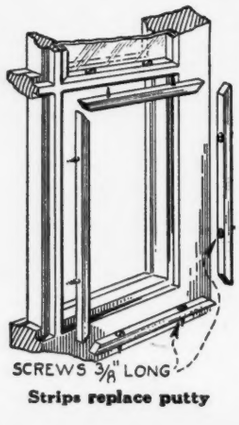


Diagram of ironing board in raised and lowered positions

No bothersome hooks or catches are necessary to keep the board up, and no holes have to be made in the plaster wall, which is a great advantage from the viewpoint of both convenience and appearance.—WALLER C. HORNADAY.

Coal Windows

IN WINDOWS where there is a chance of breakage, such as the small lights of glass in a coal window, the use of wooden strips in place of putty is often advisable. Beading sawed from old matched boards will serve the purpose, if trued up a little with a plane. The strips should be as long as the inside measurements of the sash and mitered at the ends. They may



Strips replace putty

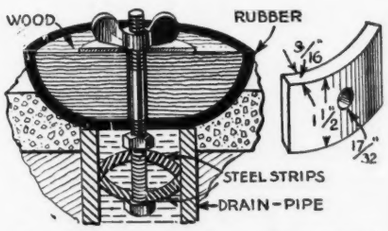
The Shipshape Home

(*Continued from page 126*)

or may not be beveled, as preferred. Fasten them in place with ⅜-in. long flat-head screws, either brass or iron, rather than with brads or small nails. If properly made and fitted, the strips should shrink very little. They will be found to save much time when the glass needs resetting.—R. C. T.

Preventing Back Flow

ANYONE who is troubled with water backing up in the basement after a hard rain, will find useful a drainpipe cap made as shown. All that is needed are two cold rolled steel strips 3/16 in. thick, 1½ in. wide, and long enough so that they will fit snugly into the drainpipe after they have been bent until the distance



Expanding clamp allows rubber-covered wooden block to be screwed tightly over drain

between them at the center, when inserted as indicated, will be about 1½ in. By placing the strips face to face on a ½-in. stud, inserting them in the drainpipe and screwing down on the upper nut, the fixture will be wedged firmly in place. The cap, which is simply a shaped wooden block faced with rubber, can then be tightened over the pipe by a wingnut.—J. M., Waukegan, Ill.

Spots on Wallpaper

IF AN extra piece of wallpaper has been saved from the paperhanger's scraps, it is not difficult to cover up a bad spot on the wall. Cut out a piece of the spare wallpaper slightly larger than the spot and quite irregular in shape. Then, with a safety-razor blade or a sharp penknife, shave away the back of the paper to form tapering edges. Paste on the patch and roll it smooth.—A. M. SMYTH, Germantown, Pa.

Finishing Chair Seats

VENEERED wooden seats sold to replace broken chair seats may be finished to match the color of the chairs on which they are placed or in colors more suitable than the clear varnish. The finished side of the new seat is past staining a new color unless the varnish is removed, but the seat may be turned over and what was intended to be the under side may be made the upper. Trim the seat to the proper shape and size and bevel the edges so that they will not be uncomfortable. Then stain the raw wood surface any shade desired, fill with either white or orange shellac, sandpaper, give coats of varnish or wax, if desired, and tack carefully in place with upholsterers' tacks.—GEORGE E. BLACK, Greencastle, Ind.

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A "Vintage Smoke"

The Major tells Joe Rivers what "tasty-smellfulness" really is

Some time ago Mr. Joe Rivers, a confirmed smoker of Edgeworth, defined the friend-making, friend-holding quality of Edgeworth as "tasty-smellfulness."

In the following letter Major Edmund simplifies this description into one word, "bouquet"—which Webster defines as "an aroma as of wine."

As a matter of fact most of us taste tobacco with our noses to a large extent.

LONDON

Dear Joe:

Your letter about Edgeworth in the "Saturday Evening Post" for 24th November demands an answer, but I am afraid this effort of mine will not reach you in time to be of much use. Some quick-firing Yankee from Bangor, Maine, will be sure to barge in between us. You have hit on something very appealing to the Englishman.

What you are talking about in your letter is "bouquet," and Edgeworth is the only tobacco possessing it, so far as I know. I tried them all, until William Forbes of Boston met me in Lucerne one day two years ago and heard me cursing the limpid Swiss air blue because I had a sore tongue. He told me about Edgeworth, and I went to the Post Office and wired London to send me out a sample. Since then—but you know the rest!

Edgeworth doesn't need any fine writing to explain it. The "bouquet" you mention varies, for it depends on what you have been eating, what you have been drinking, what the temperature of your room is, whether your pipe has been preceded by a cigar, whether you have sold out your oil shares at a profit, and how you feel *generally*.

If you write to Larus again make him pay you a royalty for your discovery (unless he saw it first), and tell him what this elusive beauty really is that has made him famous in two worlds.

Yours faithfully, Joe,
JAMES EDMUND.

We try to put into the blue tin a tobacco that has the quality of *friendliness*.

This quality may mean "comfort" to one man, "flavor" to another, "tasty-smellfulness" to Mr. Rivers, and "bouquet" to Major Edmund. There may, indeed, be some doubt as to just *what* it is, but there can be no doubt whatever that a great many men recognize its presence.

You may not find Edgeworth to your taste, and then again you may. It may prove to be just the *right* smoke for you as it has for so many others.

At any rate we'll be glad to have you try it at our expense. Just write your name and address on a postcard and mail it to Larus & Brother Company, 59 South 21st Street, Richmond, Va., and you will receive, postpaid, generous samples of both Edgeworth Plug Slice and Ready-Rubbed. If you care to write the name and address of your regular tobacco merchant the courtesy will be much appreciated.

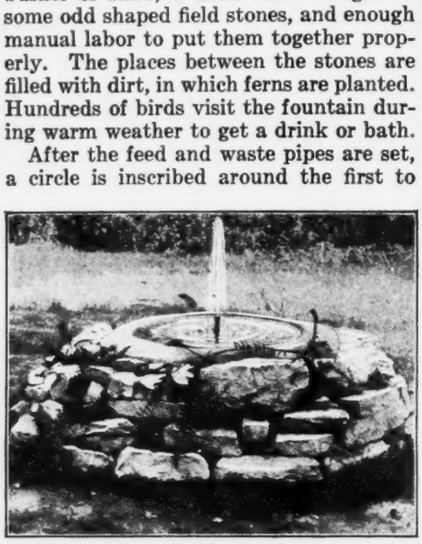
To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Stone Bird Bath Is Artistic Garden Ornament

By Herbert C. Crocker

TO BUILD the artistic bird bath shown requires only a sack of cement, a bushel of sand, a little effort to gather some odd shaped field stones, and enough manual labor to put them together properly. The places between the stones are filled with dirt, in which ferns are planted. Hundreds of birds visit the fountain during warm weather to get a drink or bath.

After the feed and waste pipes are set, a circle is inscribed around the first to indicate the outside dimension. A mound of dirt may then be built in the center to save all but the outer course of stone. This dirt also assists in holding moisture for the roots of the ferns. A portion of the dirt near the center of the mound is removed to allow the construction of the basin, which is made of cement and sand about 2 in. thick, and from 4 to 6 in. deep in the center.

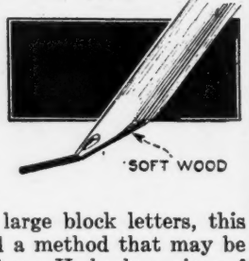


Built over an earthen mound, this attractive fountain requires little cement and stone

The waste pipe is set to maintain a depth of 3 or 4 in. of water. An old garden hose nozzle may be used to provide the spray. The overflow pipe may empty into a sewer, a cesspool or stone hole, or any convenient type of drainage may be provided.

Pen for Drawing Heavy Letters Whittled from Wooden Stick

FROM a professional sign painter I learned the little trick illustrated of cutting a heavy lettering pen from a stick of soft wood. It can be whittled quickly with a penknife and the width can be regulated within reason to any size desired. When properly made the pen draws clear-cut lines of a uniform width.



In laying out large block letters, this sign painter used a method that may be new to some readers. He broke a piece of round blackboard chalk off the same length as the width of the letter stems, and then, holding the piece sideways, drew the letters in place with single strokes. This gave him at once the exact width of line required. When the lettering was properly spaced, he outlined the letters in pencil.—H. T.

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Modern Dining Alcoves

(*Continued from page 81*)

for both benches. The stretchers and back rail are doweled; the other rails are screwed to the legs. The screws are covered with small caps ⅛ by ¾ by 2¼ in., which are glued and braded in place to give the appearance of tenons projecting through.

The seat back is merely a frame with ornamental panels. The top and bottom stiles are 1⅛ by 4 in. by 4 ft. 4 in. and are plowed to take the panels. The rails are 1⅛ by 3½ by 17½ in. The panels are ⅜ by 6½ by 17½ in., 14 being required. They are intended to be fastened together and cut all at once on a bandsaw, which is a very simple operation, but the home worker can prepare them with hand tools, if he wishes, or simplify the design in any way he pleases. In fact, plain panels would look very well and are often used in good work of this kind.

Beneath the feet are placed small shoes, 1½ by 2½ by 3 in. Twenty-four dowels

Fig. 4. A breakfast nook often gives additional service as a children's play corner

⅜ in. in diameter and 2⅛ in. long, as well as screws and glue, will be required.

The table top is 1⅛ by 2 ft. 6 in. by 4 ft. 6 in., and the table stands the usual 30 in. from the floor. The legs are 1¾ by 1¾ by 26⅝ in. The base feet are 1¾ by 2½ by 20½ in.

The top cleats are 1¾ by 2½ by 28 in. and the legs are notched to suit them, as indicated in Fig. 2. Each pair of legs is connected by two end rails ⅞ by 2½ by 12 in. Between each is placed a panel to match the seat panels, ¼ by 4 by 9½ in. Between the upper end rails runs the table shelf, ⅞ by 11 in. by 3 ft. 1 in. Two stretchers ⅞ by 2½ by 3 ft. ½ in. join the feet and brace the whole construction. Four feet shoes, ½ by 2½ by 3 in., 36 ⅜-in. dowels 2⅛ in. long, screws, and glue are required also.

In constructing the design shown in Figs. 3 and 4, fewer parts and less joinery are called for. Once the ends of the bench and table are prepared, the work is relatively simple. It is advisable to have these large pieces cut on a bandsaw at a mill or carpenter shop, but they can be prepared at the cost of a little time and effort with a compass saw and ordinary hand tools.

(*Continued on page 130*)

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Modern Dining Alcoves

(*Continued from page 129*)

The ends of the benches are 1⅛ by 18½ in. by 3 ft. 8 in. If stock wide enough cannot be obtained, they will have to be glued up. By laying out one within the other on the board, they can be cut without much waste of material. The ornamental openings are made with an expansive bit in a hand brace, but if such a bit is not part of the builder's tool equipment, openings of other shapes may be sawn out after holes are first bored for the point of the compass saw to enter.

The seats are 1⅛ by 17 in. by 4 ft. 3¾ in. Underneath the front edge of each seat runs an apron ⅞ by 2⅞ in. by 4 ft. 3¾ in. A brace ⅞ by 4 in. by 4 ft. 3¾ in. holds the ends together at the bottom. The back is simply a large frame with a single panel of 5-ply veneered stock. The top stiles are 1⅛ by 4 in. by 4 ft. 5¼ in. and the bottom stiles 1⅛ by 5 in. by 4 ft. 5¼ in.; the end rails are 1⅛ by 4¼ by 19 in. (really 18 in. between the shoulders, as the joint between the rails and stiles is a tongue-and-groove joint, doweled). The panels (one for each bench) are ⅜ in. by 19 in. by 3 ft. 10 in. The seats are carried on cleats 1⅛ by 1½ by 15 in. Twelve glue blocks ⅞ by ⅞ by 3 in., 24 ⅜-in. dowels 2⅛ in. long, screws, and glue also will be needed.

Make All Measurements with Care

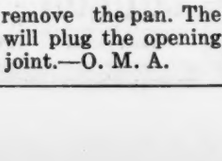
The table top is 1⅛ by 30 in. by 4 ft. 6 in.; the table ends are 1⅛ by 16 by 29⅞ in., and the shelf is ⅞ by 11 by 36¾ in. The cleats for the table top are 1¾ by 2 by 28 in. The stretcher at the bottom is ⅞ by 4 by 36¾ in. Twelve dowels, screws, and glue also are needed.

Properly made, either one of these dining alcoves will be well worth the most careful finishing. Sandpaper all the surfaces perfectly smooth and then apply enamel undercoating and enamel, or stain and varnish to match the trim of the room.

Working drawings for both designs, as well as complete bills of materials and full-size views of the important joints are contained in Home Workshop Blueprint, No. 33, which will be sent to any reader for the nominal charge of 25 cents to cover the cost of blueprinting, handling, and mailing. Address Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

Making a Cesspool Top

TO MAKE a tight-fitting and strong cover for either a new cesspool or an old one being repaired, is a simple matter if an old dishpan is used as a form. Build up the sides until they surround the pan closely, as illustrated, and fill in around the pan with cement. Also fill the pan itself and bury a handle in the moist concrete. When the cement is hard, remove the pan. The concrete slab then will plug the opening and make a perfect joint.—O. M. A.



A dishpan is used as a form

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Emotions—The Fuel of Life

(*Continued from page 38*)

men always to be clean, neatly dressed, punctual, and respectful to their employers were founded not alone on common sense, but on sound psychology, for the emotions of others are moved by the impressions that we make through our appearance, voice, and demeanor.

The most important of these, I should say, is demeanor. The man who is bad tempered and who shows it on trivial occasions, creates a bad impression—an impression that may influence his success and happiness throughout life.

The difference between the successful man and the unsuccessful man is that the former does not betray his terror, his weariness or his defeat, but continues to fight, no matter what the odds against him. He achieves success by controlling his emotions. In doing so, he stirs the emotions of others, who cannot but admire and respect his steadfastness and courage.

There is an interesting term—"psychic contagion"—that expresses the extraordinary power of strong emotion to pass from one person to another quite as disease spreads in an epidemic. "The psychology of the crowd" is another way of saying the same thing.

A year or so ago at a baseball game in an Eastern city, I saw a typical American crowd suddenly become an unruly mob when an umpire made a decision unfavorable to the home team at an important stage of the game. Bottles and other missiles began to rain on the field, and the roars of the angry spectators were terrifying.

What "Psychic Contagion" Will Do

And yet the vast majority of the individuals composing that crowd were decent and respectable members of society, law-abiding and orderly under normal conditions. Apart from a crowd, few of them probably ever would be angered to the point of attempting to assault another with a dangerous weapon. Yet so strong is the force of example, so fierce the power of emotion when aroused, that the most peaceful man in those stands probably approved the action of the ruffians who led the assault on the umpires and players.

Under the stress of such emotion lynchings and similar violent outbreaks take place. Many of the men who make up a mob undoubtedly would condemn in cold blood the activities in which they take part while under the sway of emotional excitement. The fatal panics that often accompany shipwrecks, fires, floods and similar disasters are due to the same sort of psychic contagion.

On the other hand, serious panics and scenes of violence have been averted because some one has possessed the coolness and courage to instill in a crowd some emotion other than the terror or rage which is actuating it. A most significant instance of this sort occurred during the war. A column of French soldiers was marching through a little town in the center of which was a large open square. German gunners ten miles away had the

(*Continued on page 132*)

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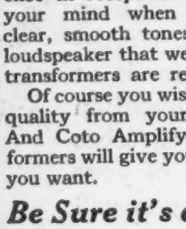

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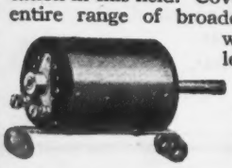

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Emotions—The Fuel of Life

(*Continued from page 131*)

range of the square, and were dropping shells into it at irregular intervals. The soldiers, of course, discovered this fact. Despite discipline, they feared to cross the square and sought to pass round the edges, thus creating confusion.

A French general of very ample proportions ordered a large armchair to be placed in the middle of the square, and, with a light cane in his hand, settled himself comfortably in the chair and joked with the soldiers as they marched by. Though the bursting of shells in the square continued, not a soldier flinched after the general had taken his station. Though inwardly they may have felt timorous, none would exhibit signs of fear.

For, though cowardice and rage are contagious, so is courage. In fact, the better emotions seem to be transmitted more readily than evil emotions. We learned during the war that it does not need the rigid discipline of military life to produce morale.

Learn to Control Emotion

Such control and direction of emotions not only is possible but entirely useful. Much has been said in recent years of the evil effects of repressions of the feelings and emotions. All this, though, comes from a school of treatment of nervous diseases that has no meaning for ordinary, normal individuals. Persons whose minds are disturbed and who by heredity have tendencies to nervous manifestations sometimes may disturb their mental equilibrium by their exaggerated efforts to repress some of their tendencies. The great majority of mankind, however, is benefitted by habits of repression.

Nurses, physicians, clergymen and others who attend the sick always have controlled their emotions. In fact, most sensible persons whose work has brought them into intimate contact with their fellow men have learned repression.

Psychology is intensely practical. Its principles may be applied to the benefit of every one in the ordinary activities.

As with our senses in the acquisition of knowledge, so with our emotions; they cut rapidly into the grooves of habit according to the use we make of them. Cultivation of our better emotions and repression of our less worthy ones—ruling our emotions rather than permitting them to rule us—these are the methods by which character is formed.

There is no illusion in that expression, "the formation of character." For a man can make himself ever so much better than he would naturally be, and in the same way can let himself become ever so much worse than he might be. It is all a question of guarding the emotions and seeing that they work for our benefit.

HOW long are your legs? Did you know that the length of your limbs in proportion to the length of your body may, to an extent, be a measurement of your intelligence and your success in life? In next month's issue Henry E. Garrett, Ph.D., of the Department of Psychology, Columbia University, will tell how you can apply these measurements.

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Science Sees, Hears, Counts Atoms

(*Continued from page 45*)

incandescent lamps that light your home, the arc lights on the street corners—these all perform their functions because electric current is flowing through them. And electric current, it has been shown, is simply the passage of electrons from one tiny atom to the next.

If you will imagine a piece of copper wire as made up of a line of atoms, you can visualize how this operation takes place. Take a single electron from the last atom of the wire and add it to the first atom. You probably can picture the process best if you think of it as resembling one of the basketball relay games that children play. As soon as you've transferred that electron, the atoms all along the line immediately busy themselves trying to get it back to place. The first atom hurls it back to the second, the second to the third and so on, each little atom seemingly intent upon keeping only its normal quota of electrons and no more.

That is the way electric current flows. In some substances—copper, for example—the electrons seem to be less strongly attracted to their nuclei than in other substances. The atoms of copper pass electrons from one to the next very readily. And so copper is called a good conductor. In other substances, such as rubber and glass, the electrons are bound very tightly to their nuclei, and cannot be passed from atom to atom. These substances are known as non-conductors or insulators.

The Most Enormous Force Known

The energy of atoms is the most enormous force that science ever has discovered. Since atoms are so infinitely small, this may seem incredible. Consider, though, the difference in destructive potentiality between a five-ton motor-truck, merely rolling along at a mile an hour, and a shell weighing less than 100 pounds but traveling at a speed, say, of a thousand feet a second. If both the truck and the projectile were to strike a brick wall, you would not hesitate to predict far different results.

That, then, is the secret of the tremendous energy of the atom—its enormous velocity. That, too, is what has permitted scientists to study atoms and to photograph atoms. Sir Ernest Rutherford was the first to discover that the phenomenon called radioactivity was due to the fact that radioactive substances were throwing off free atoms. In the case of radium, he demonstrated that the emanations consisted of atoms of helium. That is to say, radium is constantly altering its substance. It is an alchemy, a transmutation performed by the master chemist, Nature, that in time will result in the transmutation of radium into lead.

Rutherford discovered further that the splash of light from an atom cast off by a radioactive substance was visible against a fluorescent screen, and that its path in the air was outlined by condensation of the water drops it left in its wake. These phenomena permitted the movements of

(*Continued on page 134*)

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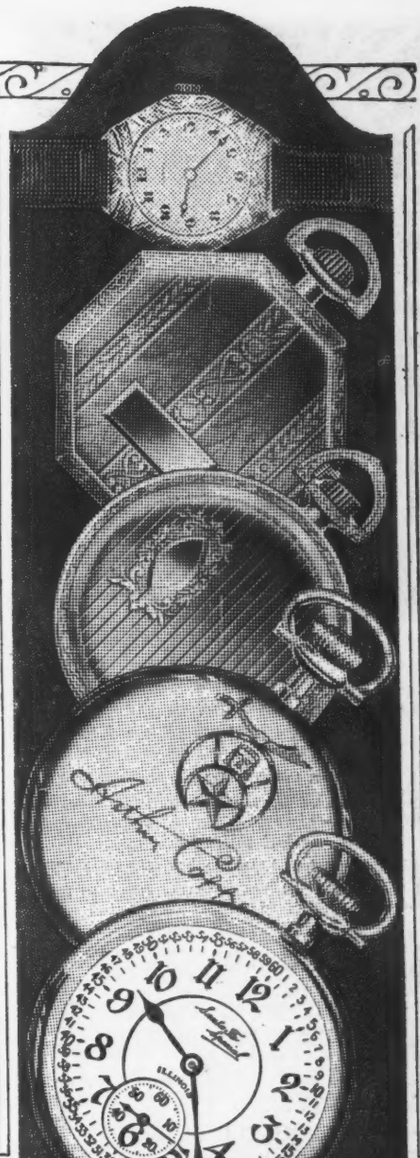

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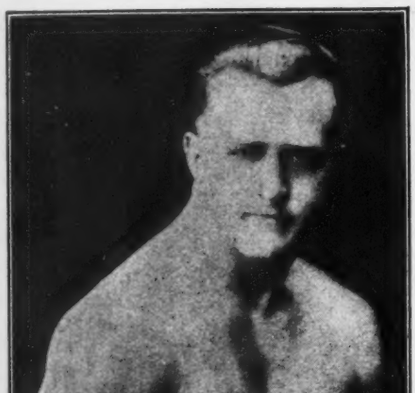

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before you start to fight? Do you need this kind of treatment to bring you to your senses? If you are that kind of a fellow, the chances are strong that you are going to get it.

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THE WISE MAN

Some men never pay any attention to the condition of their house till it begins to fall on their head. Others watch for the first sign of a crack and immediately have it put in condition. How about the house you live in—your body? Are you going to let it clog up and waste away until you suddenly realize you have tuberculosis or some other dreadful, incurable disease? Get wise! Check up on yourself! Put your body in shape and keep it so.

An apple is no good unless you eat it. Let it lie, and it will rot away. Let your muscles lie idle and they will waste away, but *use your muscles and you have more muscle to use.*

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That's what they call me. I don't claim to cure disease. But I do absolutely guarantee to make a strong, husky man out of anyone who will give me a chance. If you wait until some disease gets you, the doctor is the only one who can save you—but come to me now and the doctor will starve to death waiting for you to take sick. I'll put one inch of solid muscle on your arm in just 30 days and two inches on your chest in the same length of time. But that's only a starter. I'll put an armor plate of muscle over your entire body and build up the walls in and around every vital organ. I'll shoot a quiver up your spine that will make you glow all over. You will have a spring to your step and a flash to your eye that will radiate life and vitality wherever you go. And what I say doesn't just mean *maybe.* I absolutely guarantee these things. Are you with me? Come on then. Let's go.

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Science Sees, Hears, Counts Atoms

(Continued from page 133)

atoms to be photographed, and also led to the invention by Madame Curie of the machine that makes atoms audible.

Scientists believe they can demonstrate the form in which atoms group themselves in various substances by observing the shapes that those substances assume in forming crystals. They reason that if the crystalline formation is a triangle, say, or a star, it must be because the atoms that make up the crystal are arranged in a triangle or star.

While much has been learned about the form, structure, and potentialities of atoms, their enormous energy cannot yet be controlled. Methods of disturbing the electrons have been found, but the disruption of the nuclei requires greater forces than science has at its command.

If it were possible to inject another positive charge of electricity into the nucleus of hydrogen and form helium—the element standing next to hydrogen in the atomic scale—the operation would involve the destruction of matter, a process that always releases energy. In burning a piece of wood, for example, you liberate quantities of energy in the form of heat.

Tremendous Sources of Energy

Science can compute the amount of energy that would be made available by effecting the transmutation of various substances, and its magnitude defies description. If you were to take a sheet of paper the size of this magazine page and cover it completely with the smallest figures you could write, the resulting figure would not begin to express in tons the amount of energy that would to released by the transmutation of the carbon in a single ton of coal! The amount of energy liberated by the transmutation of the hydrogen contained in a tumbler of water, would suffice to drive the airship *Shenandoah* around the earth.

Realization of these astounding facts marks the first step in what future generations may have occasion to call the greatest achievement of the human race—harnessing the minute but mighty atom, forcing it to open to man its jealously guarded wellspring of power. Because what has been learned regarding atoms, the patiently built edifice of our knowledge of the natural sciences threatens to topple. Now that the structure of atoms is known, their cohesion to form matter is unexplainable by known laws of physics. An atom existing independently is understandable, but atoms united in substances we see are not!

With regard to atoms, man today may be said to be in a position similar to that which primitive man occupied before he evolved a method of making fire. Primitive man saw fire in the sun, in the thunderbolts that flashed in the sky. He realized its power and how it could serve him, but he did not know how to produce it. Then he learned how to make fire, and from that day his progress dates.

How much greater will be the progress of the inhabitants of the earth if they learn to utilize the power of atoms!

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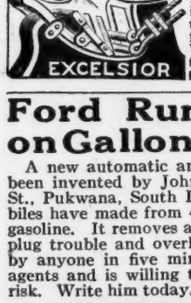

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Adventures in Home Ownership

(*Continued from page 72*)

"What have bed springs to do with a comfortable night's sleep?" I laughed. "If the springs give way, you go down with them, don't you? And if foundations settle, the walls and floors settle with them; and when the walls settle, the plaster cracks. In this house, too, the cracking has been aggravated by inadequate underpinning. See the sag in that floor beam just at the base of a partition? That means more cracks."

And so I pointed out other glaring defects—the lack of sufficient supporting posts, slovenly bracing, and careless workmanship.

We trudged up the stairs for a rather forlorn visit to the second floor. Here were three delightful bedrooms, each with a spacious closet, and a tiled bath equipped with excellent porcelain plumbing. All opened into a small, but adequate hall. Yet at first glance we saw that the cheeriness of each room was marred by ugly stains on the plaster, usually near a window. They were stains from leaking water, evidence of shoddy construction of the roof, exterior walls or window frames. One door, we found, would not close because the frame of the house had sagged.

By this time I saw that Marion's first bright hopes had gone glimmering.

"It's a shame," Jim muttered.

"I agree," I echoed. "Here is an unusually attractive house, equipped with every modern comfort, all ruined by poor workmanship."

We Visit an Old House

"What about buying an old house—one that people have lived in long enough to know that it is well built—and fixing it up?" asked Marion when we were seated again in the car.

"That all depends," I replied. "I have seen the most wonderful homes created by remodeling an old house. It's a fact that some houses built before the war are better built than is the rule today. Sometimes they can be bought for less than it would cost to duplicate them now."

"Here's an old house on the list," volunteered Marion. "Let's look at it."

Arriving at the listed address, we found a deserted residence that evidently once had been the pride of a fastidious owner. It was set far back from the street, high upon an immense lot that held half a dozen beautiful shade trees. What once had been a well-groomed lawn, bordered by a handsome stone wall, now was a tangled mass of long grass and weeds.

A closer inspection revealed that first of all, the house would need a new coat of paint. The cedar shingles of the roof were curled and broken. That would mean a new roof. The floor and pillars of the porch were rotted away in places. That might mean a new porch, or at least extensive repairs. Inside, the wall-paper was faded and torn, the woodwork was marred and dingy, and in places the plaster was broken. That would mean new decoration throughout, and some re-

(*Continued on page 136*)

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Adventures in Home Ownership

(*Continued from page 135*)

plastering. The kitchen and bathroom fixtures were old fashioned and inclosed in woodwork where they could not be kept clean easily. The fixtures themselves were stained and chipped, and showed signs of developing unsanitary leaks. Probably they would have to be replaced.

"Well, what do you think of it?" asked Jim when we had completed a tour of inspection.

"I think it's a first-class house, and I wish more were being built like it now," I told him. "But here's the question: Would it be worth the cost of repairs to you? Let's figure it out.

"The listed price is $8500, isn't it? That's cheap, considering the size of the place. From what I have seen I should estimate that painting and repairs would cost at least $1500 at the lowest possible figure. That would bring the price to $10,000. Then figure in a new heating plant and bathroom and modern kitchen fixtures—a good $1000 more, not to mention incidental improvements.

Is the House Worth the Expense?

"Now the question is this: Could you buy a new house for $11,000 or $12,000 that would give you better all around service and satisfaction than this old one remodeled? Remember, you've got to consider your home as an investment, with an eye to the resale value, just as you would in buying an automobile. That's why it always pays to have a home that somebody else will like as well as you do. In a new house, you look for evidence of faulty materials and workmanship. In an old house you consider the condition of the building in comparison with its age. Is this house worth the cost and trouble?"

We all agreed it was not. And so we set out again in our quest for a home.

In the next four or five places we visited we found the question of location to be one of the chief obstacles, aside from other considerations. One house was in an objectionable, deteriorating neighborhood—a vitally important drawback where there are small children in the family. Another was too far distant from railroad and street-cars. Still another faced on a highway where automobile and street-car traffic was exceptionally heavy. A fourth was too far removed from schools and from fire and police protection. A fifth was unpleasantly near stores and public garages. In each case the property seemed destined to deteriorate, rather than to increase in value.

But at last, after a day of disappointments, our search apparently was to be rewarded. As we drew up before a sturdy Dutch colonial cottage, in a neighborhood of moderately small, but distinctive new homes, we seemed to feel instinctively that this was to be *the house*. Of frame construction, it stood comfortably back from the street on a 75-foot lot of apparently firm, well drained soil sloping away from the house. At the front was a fine old shade tree.

"This looks like the real stuff—it looks

(*Continued on page 137*)

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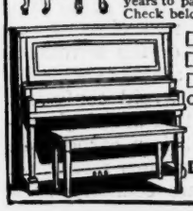

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Adventures in Home Ownership

(Continued from page 136)

like home," was Jim's comment as we entered. And that probably described the dwelling better than any other words. It possessed most of the advantages of the first house of our acquaintance, without any of the defects. More important, it immediately imparted the impression of solid durability in contrast to the flimsy showiness we had discovered in the other.

A wide, inviting porch extended across the front. From there, through a small hall we found ourselves in a living-room the length of the house—Marion's coveted living-room and fireplace all over again. But this time the walls were solid and the hardwood floor was level and even as a skating rink. Built-in bookcases gave added charm to the Dutch fireplace.

Marion's spirits rose as quickly as they had fallen. But she was taking no chances of having them dashed a second time.

"I'm going down to the cellar the very first thing," she announced. And she was gone.

An Electrical Home

"Dry as a bone," she reported. "You men can come and see for yourselves. And do you know what I discovered? There's a clothes chute to the laundry. Then in the basement and in the kitchen there are lots and lots of electric wall plugs everywhere, for the washing machine, the iron, the dishwashing machine, the toaster—and everything!

"Won't it be fun—just to plug in and let the machines do the work! See, here are more plugs in the living-room for our lamps and our tea parties."

"Rave on, young woman," broke in Jim tolerantly. "How about the kitchen breakfast nook and the built-in kitchen cabinet?"

"They're minus, but that doesn't make any difference. You always carry your breakfast to the train in your hand, anyway. And besides, we have a kitchen cabinet of our own that we can move here and use perfectly well."

But she was gone again—this time upstairs.

"Come quick, both of you!" we heard her calling a minute later.

We met her at the head of the stairs. She was radiant.

"The grandest sleeping porch you ever saw," she was saying. "Just like a fourth bedroom all the year round."

We stood in admiration before this latest of attractions, when Jim suddenly and rudely shattered a blissful silence.

"Now listen here. All this is great. But the insignificant question now arises—what does it cost and just how are we going to pay for it? You know we weren't to go above $8500 or $9000 at the most."

Marion's hands dropped limply.

"Jim, I never thought of that!"

She fumbled in her bag for the crumpled slip of paper, unfolded it, and read down the list—

"It's ten thousand dollars!"

Read, in next month's issue, how Jim and Marion financed their new home.

The Opinion of 1,000 Others

To find out what influences ambitious men and women to enroll with the American School, an advertising agency sent out a questionnaire to one thousand names, taken at random from our student rolls. The answers to three of these questions show very clearly how our School is regarded by our students, both before and after enrolling.

Why Students Inquired About Our Courses

31.5% wrote only to the American School, because our advertisements impressed them more favorably than the advertisements of other home study schools.
27.0% had heard of the American School before.
23.7% answered several home study school advertisements, so they could select the best.
15.1% were recommended to our school by a friend or acquaintance who had taken one of our courses.
2.7% inquired for various other reasons.

Why Students Considered Taking a Course With Us

37.4% wanted to qualify for better positions.
22.5% wanted assistance in their present work.
20.7% wanted more information on the subject for which they enrolled.
11.2% wanted to prepare for college entrance examinations.
7.4% wanted to "brush up" on subjects previously studied.
.8% enrolled for various other purposes.

What Students Really Think About Our Courses

97.2% say our courses are "Good."
1.4% say our courses are only "Fair."
1.4% say our courses are "Not what they expected."

When you take the average opinion of 1,000 people, selected at random, about some one thing, you will get a definite idea as to the worth of the thing. The average opinion of these 1,000 people is that our courses are O. K. Do you need further proof? If you want to get ahead and are considering a course of practical training, you will find that the American School is the best place to get that training. From us you will get the best grade of training at the lowest cost. And further—

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You cannot lose when you enroll with us. If after you have finished your course you are not absolutely satisfied, if you do not believe that the training we gave you will help you to get ahead, just write us and we will refund to you every cent you paid us. Mark the coupon. Your request for information puts you under no obligation and no AGENTS WILL BOTHER YOU.

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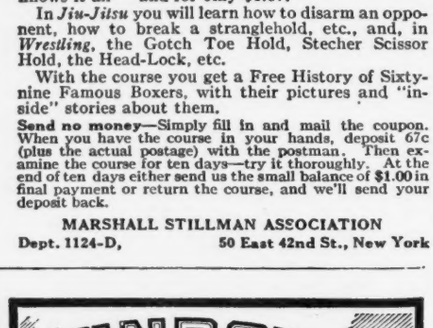

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Metallic Letter Co., 433-A N. Clark St., Chicago

Loudspeaking Three-Tube Radio Receiver

(*Continued from page 75*)

double cotton-covered wire can be used. The number of turns on each winding should not vary more than five turns more or less than the number specified.

Number 8 is a combination grid condenser and leak. The grid condenser should have a capacity of .00025 mfd. and the grid leak, a resistance of 1 to 2 megohms. Separate grid condenser and leak connected in parallel will do as well as a combination grid condenser and leak.

Numbers 9, 16, and 20 are vacuum-tube sockets. In this case sockets for storage-battery tubes were used, but dry battery tubes and sockets also can be used to advantage. In wiring them together, follow the wiring directions for connecting the various terminals, regardless of the different arrangements of the terminals. The *F* terminals of the sockets should be marked *F1* and *F2* to avoid confusion.

Numbers 11, 18, and 24 are single-circuit jacks. Number 12 is a carbon pile type of rheostat, of six ohms resistance. Numbers 17 and 21 are ordinary wire-wound 6-ohm rheostats.

Ratios of Transformer Windings

Numbers 13 and 22 are standard audio-frequency transformers. Transformers having a ratio not higher than five to one should be used for best results, although if desired, a higher ratio transformer can be used for the first stage (No. 13).

Number 14 is the negative B battery terminal; No. 15 the positive 22½-volt B battery terminal. If a hard or high vacuum tube is used as the detector, better results usually will be obtained if this terminal is connected with a higher voltage ranging up to about 45 volts.

Number 19 is the C battery. If a standard 4½-volt C battery is used, it can be placed inside the cabinet in a slot cut into the baseboard as shown. The terminal of the battery marked *A* is the positive pole; *B* is the negative three-volt terminal, and *C* is the negative 4½-volt terminal.

Number 23 is the terminal connected with the plate circuit of the second tube or first stage amplifier. The lead from this terminal to the B battery should be tried on various terminals ranging from 45 to 90 volts and left connected with the terminal that gives best results.

Number 25 is the terminal connected with the plate circuit of the last tube. The lead from this terminal can be connected with B battery voltages ranging from 90 to 112½ volts, or more, depending on the tube and loudspeaker used in the last stage. If a power tube and a rugged loudspeaker are used, voltages as high as 300 volts can be applied to the last stage.

Number 26 is the positive A battery terminal and No. 27 is the negative A battery terminal.

Bus bar wiring will give a neat and workmanlike appearance to the set.

No difficulty will be experienced in wiring the receiver if the following directions given below are observed:

First mount all the parts, with the exception of the two variable condensers, on

(*Continued on page 139*)

Loudspeaking Three-Tube Radio Receiver

(*Continued from page 138*)

a seven by 24 inch panel. The baseboard should be 23 inches long by 6½ inches wide. A board ¾ to 1 inch thick will serve well. Then begin connecting the taps of the primary and secondary coils with their respective switch points.

The beginning of the primary winding, *5A*—that is, the end nearest the secondary winding—is left unconnected. Later this will be connected with the aerial post. The beginning of a winding is always referred to as the "zero tap." The No. 1 tap, at the end of the tenth turn, is connected with the top switch point of switch 4; the second tap is connected with the next switch point and so on down till the last or fourth tap at the last or fortieth turn is connected with the fourth switch point.

Connecting the Secondary Winding

The zero tap at the top end of the secondary winding, *5B*, is connected with the top switch point of switch 6; the next, or No. 1 tap, is connected with the next switch point and the rest of the taps are connected with the respective switch points of switches 6 and 7 as shown.

Next, mount the condensers and go on with the connections.

Now begin the wiring of the set proper by connecting the aerial post 1, the *A* terminal of condenser 3 and the top end, or zero tap, of winding *5A*. Then connect the *B* terminal (rotary plates) of condenser 3, the switch arm of switch 4 and ground post 2.

A wire is used to connect the stationary plate terminal *A* of condenser 10, the switch arm of switch 6 and one terminal of the grid condenser and leak 8. The other terminal of the grid condenser and leak is connected with the *G* terminal of socket 9. Next run a wire from terminal 26, leading over the *F1* terminals of sockets 20 and 16, connecting with terminal *F1* of socket 9, and ending at terminal 14. Short lengths of wire are used to connect this wire with the rotary plate terminal *B* of condenser 10, the *F1* terminals of sockets 16 and 20, the positive or *A* terminal of C battery 19 and the switch arm of switch 7.

One terminal of rheostat 12 is connected with the *F2* terminal of socket 9. A wire then is run across the panel connecting the remaining terminal of rheostat 12, the *B* terminals of rheostats 17 and 21 and binding-post 27.

The *A* terminal of rheostat 17 should then be connected with the *F2* terminal of socket 16. The *A* terminal of rheostat 21 is connected with the *F2* terminal of socket 20.

One lead from the rotor winding is connected with the *P* terminal of socket 9. The other lead connects with one spring of jack 11 and the *P* terminal of transformer 13. The other terminal of the jack is connected with terminal 15, and another wire connects this wire with the *B* terminal of transformer 13.

The *G* terminal of transformer 13 is connected with the *G* terminal of socket 16, while the G terminal of transformer 22 is connected with the *G* terminal of socket

(*Continued on page 140*)

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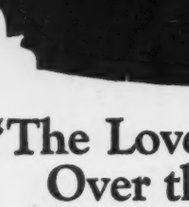

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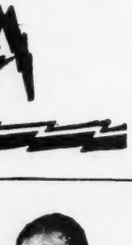

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1714 Fyr-Fyter Bldg. Dayton, Ohio

Loudspeaking Three-Tube Radio Receiver

(*Continued from page 139*)

20. A wire from the *F* terminal of transformer 13 and another wire from the *F* terminal of transformer 22 are connected temporarily with terminal *C* (minus 4½-volt tap) of C battery 19. Later when the set is in operation these wires can be tried on either of the negative terminals of the C battery and connected with the terminal that gives best results.

The *P* terminal of socket 16, the *P* terminal of transformer 22 and one terminal of jack 18 then should be connected. The spring of the jack with which this connection is made should correspond to the one used for a similar connection in jack 11. The other jack terminal, terminal *B* of transformer 22, and terminal 23 then should be connected.

Now connect the *P* terminal of socket 20 with one terminal of jack 24. The other terminal of jack 24 is connected with terminal 25. This last connection completes the internal wiring of the set.

Battery Connections

To operate the receiver, the positive of the A battery is connected with binding-post 26, and the negative of the A battery is connected with binding-post 27. The negative of the B battery is connected with terminal 14. If a soft tube is used, the 22½-volt terminal of the B battery is connected with terminal 15; but if a hard tube is used as a detector, the lead from terminal 15 should be tried on various values of B battery, ranging from 22½ to 45 volts. Terminal 23 is connected with a B battery terminal of from 45 to 90 volts, while terminal 25 is connected with a B battery voltage of from 90 to 300 volts, depending on the tube and loudspeaker.

If a 180-degree coupler is used, it may be found necessary to reverse the connections to the rotor winding leads. This is due to the fact that regenerative action cannot be obtained if the polarity of the tickler coil with respect to that of the secondary coil is not correct.

A good way to begin feeling for a station is to try the switch arm of switch 4 on the top switch point, and then vary the adjustments of switches 6 and 7. For every combination of switch settings try varying the adjustment of the condensers and the tickler coil throughout their ranges. By recording adjustments or combinations that give best results you soon will be able to tune in any desired station with ease.

To obtain best results all parts should be tested carefully before mounting and should be distributed on the panel and baseboard as shown in the photograph. The terminals of the various instruments should be so arranged that the wiring between parts will be as short and direct as possible. In wiring, try to route the wires so that no two wires are close to each other or run parallel for any considerable distance. The only exception to this rule is in the case of the filament leads from the A battery.

Next month Mr. Calcaterra will describe how to build the various types of tuning elements.

Here Are Correct Answers to Questions on Page 29

1. Color is caused by differences in the length of light waves. Our eye sees the longer waves as red; the shorter, as orange, etc. The shortest waves of visible light are violet. White light consists of light of all the colors.

2. The explosion of dynamite is very different from burning; it is a kind of disintegration. All the atoms fly apart from each other very suddenly. Mere burning will not make the atoms fly apart.

3. It is believed that the two billion or so stars that we can see in a telescope all belong to a great group or cloud that has somewhat the shape of a watch. We are near the center. Accordingly, as we look out toward the edge of the watch we look through a greater thickness of the star-cloud and we see more stars than if we could look in the direction of the face or back of the watch.

4. Microscopic plants, composed of a single living cell, grow on the food and form the mold.

5. Some persons, usually those who are not quite normal, possess a second distinct personality corresponding to what, in normal people, is the unconscious mind. These two parts of the mind may have charge of a person's actions alternately, so that he is like *Dr. Jekyll* and *Mr. Hyde* in Stevenson's story.

6. Heat is lost more rapidly through the air of the desert because the air is drier. Dry air lets heat leak away much faster than moist air.

7. The solid matter of bone is not a living substance. But scattered through the bone there are a number of living cells that are bone makers. They are able to produce the mineral material, mainly phosphate of lime, out of which bones are built up. When the ends of a broken bone are brought together again by the surgeon, these bone-making cells collect there and deposit new bone material in the break.

8. The storage battery does not produce any electricity. It merely stores up what you put in it and lets you get it back later when you want to. The dry battery makes electricity out of chemicals that were put into it when it was made. It is not really dry. It contains a watery solution of the necessary chemicals, but this solution is soaked up in charcoal or some other porous substance so that it will not spill or leak out.

9. We believe that it is because they have little or no power of having abstract ideas. Words represent such ideas. For instance, the word "man" means any man, not merely some one man with whom you happen to be acquainted. Animals do not seem to be able to take this mental step from a knowledge of some single thing to the general, abstract idea including both that thing and other things like it.

10. In the nucleus, the little speck of denser and darker protoplasm that is to be seen inside each living cell, there is a very complicated structure that scientists are sometimes able to see under a powerful microscope. This structure contains a number of tiny granules that are passed on by each cell to the cells that are formed from it. They are believed to be the basis of heredity, but the details of how they control this are still unknown.

11. Certain kinds of bacteria grow in hay. They produce heat. The outside layers of hay hold in this heat and the inside of the pile grows very hot. After a while it catches fire.

12. Their feet are built in a special way so that they can rest upon the individual threads of the web without either breaking these threads or getting stuck fast.

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